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1905	Critien, Attilio
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1904	Dee, Peter
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1906	Faichnie, Norman
1904	Greenidge, Oliver Campbell
1904	Hebir, Patrick
1905	Hooton, Alfred
1905	Hudson, Charles Tilson
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1904	Khan, Saiduzzafor
1904	Laurie, Robert
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1904	Machirkin, Alfred Robert
1905	Maddock, Edward Cecil Gordon
1904	McConnell, Robert Ernest
1905	Moore, James Jackson
1904	Nicholson, James Edward
1905	Nightingale, Samuel Shore
1906	Pailthorpe, Mary Elizabeth
1906	Palmer, Harold Thornbury
1906	Pearse, Alfred
1904	Philipson, Nicholas
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1904	Sharman, Eric Harding
1906	Taylor, William Irwin
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By order of the Committee of the Incorporated Liverpool School of Tropical Medicine, the series of the Reports of the School, which have been issued since 1899, will be followed, from January 1, 1907, by the Annals of Tropical Medicine and Parasitology, of which this is the first number.

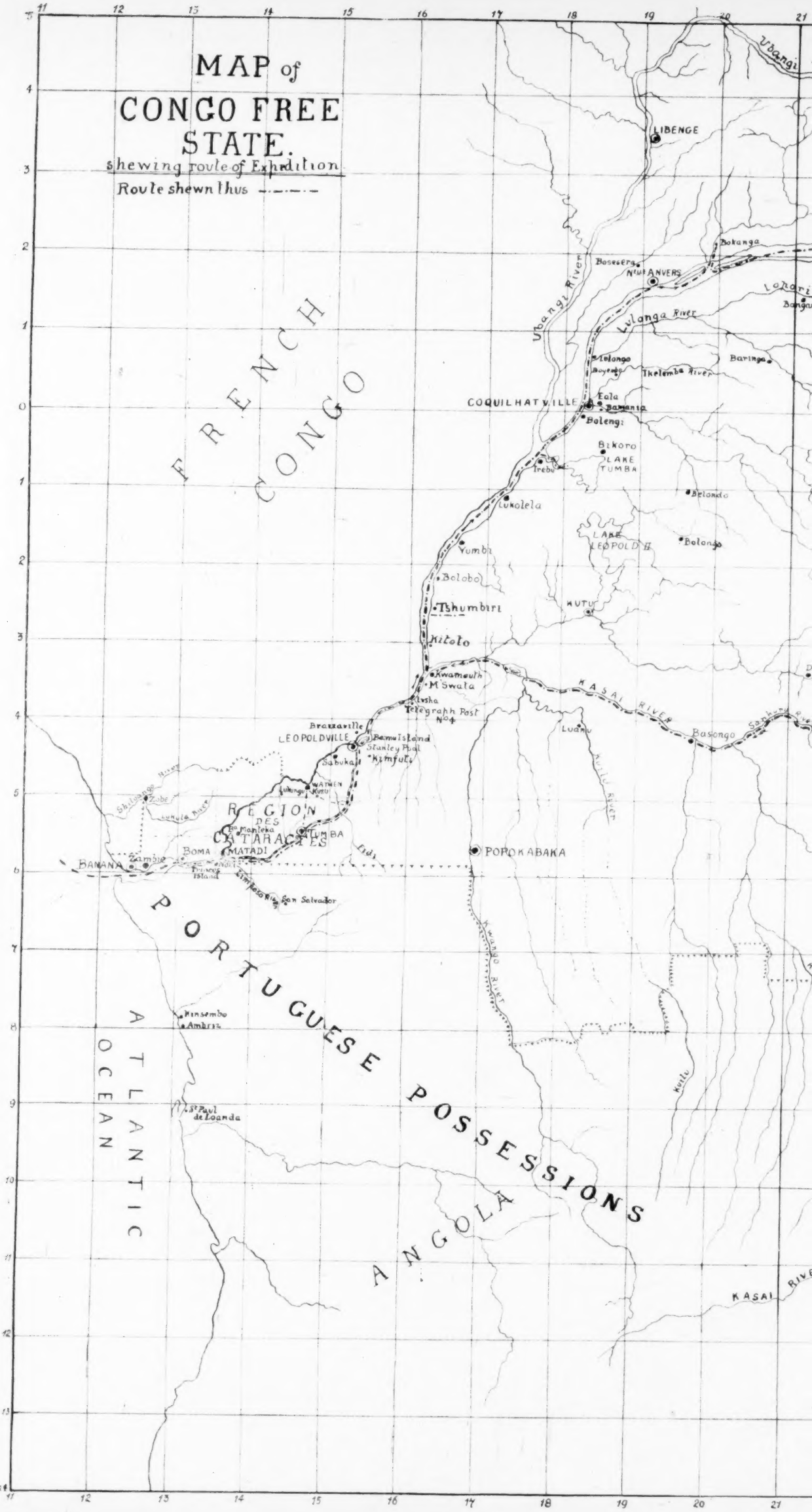
The Annals are issued by the Committee of the School, and will contain all such matter as was formerly printed in the Reports—that is to say, accounts of the various expeditions of the School and of the scientific work done in its laboratories at the University of Liverpool and at Runcorn. Altogether twenty-one Memoirs, besides other works, have been published by the School since 1899, and of these ten, containing 519 quarto or octavo pages and 95 plates and figures, were published during the two years 1904 and 1905; and there is no reason to suppose that this rate of production by the workers of the School alone will diminish in the future. In addition, however, to School work, original articles from outside on any subject connected with Tropical Medicine or Hygiene may be published if found suitable (see notice on back of cover); so that, in all probability, not less than four numbers of the Annals will be issued annually. Each number will be brought out when material sufficient for it has been accumulated.

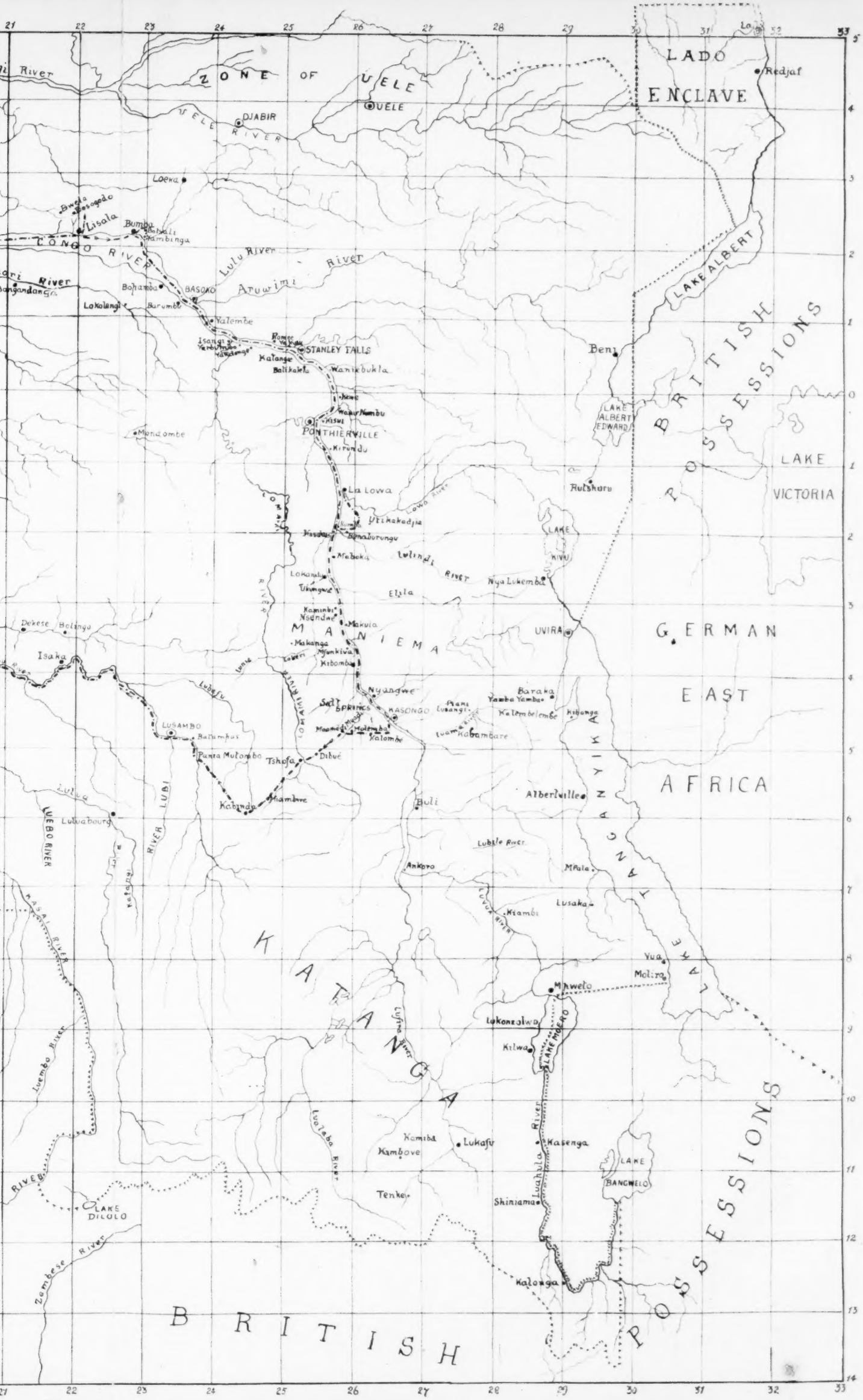
INSECTS AND OTHER ARTHROPODA COLLECTED IN THE CONGO FREE STATE

MAP of CONGO FREE STATE.

shewing route of Expedition

Route shewn thus ----

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UELE
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Lulu River
Aruwimi River
LAKE ALBERT
Bohamba
BASOKO
Lokolenge
Barumbu
Yalembe
STANLEY FALLS
Katonge
Batikatela
Wanikubula
Beni
BRITISH POSSESSIONS
LAKE ALBERT EDWARD
Mongombe
PANTHIERVILLE
Kirundu
LAKE VICTORIA
Ruchuru
Ira Lowa
Vitshakadsia
Nyanaburungu
Mabaka
Lulindi River
LAKE KIVU
Nya Lukemba
Elila
Dekese
Bolingu
Isaka
MANIEMA
Makula
Makanga
Kibombwa
UVIRA
GERMAN EAST AFRICA
Nyangwe
Sad Springs
KASONGO
Baraka
Yamba Yamba
Kalembelembe
Kibonga
LUSAMBO
Batumbas
Panda Mulombo
Tshofa
Dibué
Kabanda
Kiambwe
Buli
Albertville
RUANDA
Lubile River
Ankoro
Mpala
Lusaka
Kiambi
KATANGA
Vua
Mpweto
Lukonzolwa
Kilwa
LAKE MOERO
Luvua River
Luvua
Luembo River
Kamiba
Kambove
Lukafu
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Map I.

INSECTS AND OTHER ARTHROPODA COLLECTED IN THE CONGO FREE STATE

Being the Seventh Interim Report of the Expedition of the Liverpool School of Tropical Medicine to the Congo, 1903-05

BY

ROBERT NEWSTEAD, A.L.S., F.E.S., &c.
(LECTURER ON ECONOMIC ENTOMOLOGY AND PARASITOLOGY, THE SCHOOL OF TROPICAL MEDICINE, UNIVERSITY OF LIVERPOOL)

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AND

JOHN L. TODD, B.A., M.D., C.M. McGILL
(DIRECTOR OF THE RUNCORN RESEARCH LABORATORIES OF THE LIVERPOOL SCHOOL OF TROPICAL MEDICINE)

INTRODUCTORY

This expedition was sent to the Congo Free State, on the invitation of His Majesty King Leopold II, by the Liverpool School of Tropical Medicine to report upon the sanitary condition of the more important posts and to study human trypanosomiasis. The collection of various biting insects formed, therefore, a principal part of its work; but once the more important ones, as *Glossina* and *Anophelina*, were obtained in each district the systematic search for insects was discontinued. A large part of this collection represents then, merely the casual wayside gleanings made during a journey through Central Africa.

From the point of view of a dipterologist the collection is therefore regrettably incomplete, especially so, since a large number of specimens have been unavoidably ruined by moulds. Had time been spent in collecting, it is probable that many of those insects reported from only one or two localities would have been found to have a far wider distribution.

Twenty-three months were actually spent in the Congo Free State; during that time a distance of some 2,000 miles was travelled. The course followed by the expedition is indicated on the map; while

the dates when it was at, or passed through, the various posts are briefly mentioned below.

England was left on September 4, 1903. Banana,* the first point of call in the Free State, was reached on September 23. From September 24 to October 27 was spent at Boma, and from October 28 to November 20 at Matadi. Matadi is connected with Leopoldville by railroad. From Tumba, the half way point on the railway line, two of the members of the expedition made a trip of three weeks' duration (November 5 to 28) to Wathen and through the District of the Cataracts. A stay of seven months, from November 22, 1903, to June 23, 1904, was made at Leopoldville.

From Leopoldville the expedition went up the Congo to Stanley Falls in a small steamer placed at their disposal by the Government. When it seemed advisable, stops and short side-journeys were made at posts along the river for the purpose of studying local conditions. Work was done at M'Swata from June 25 to 29. At Tshumbiri (July 2 to 5) one night was spent at a native village some ten miles inland. Mopolengue was visited on July 7 to 9, and Irebu on July 14 to 17. From Coquilhatville (July 18 to August 9) trips were made to Eala and Bamamia. Nouvelle Anvers was visited from August 14 to 21. From Mobeka (August 22) a short journey was made up the Mongala to Bokanga (August 23). Stops were made at Lisala (August 26 to 30) and at Bumba (August 31 to September 4); at both of these places short journeys were made inland. Short stays were made at Basoko (September 7 to 9) and at Yakusu (September 13 to 15). On September 15 Stanley Falls was reached, where the expedition remained until September 28.

From Stanley Falls the journey up the Congo was continued to Kasongo by canoe. Ponthierville was visited from October 5 to October 9. From Lalowa (October 12) two members of the expedition made a side trip of 12 days' duration inland to the east of the Congo. They paralleled the river as far as Kumba, where they once more took canoe. From Lokandu (October 16 to November 1) a journey of some 18 miles was made inland. Stops were made at N'Sendwe (November 4 to 8), and Nyangwe (November 13 to 22). Kasongo was reached on November 23, 1904. A stay of five months

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* See Map 1, page 1.

was made at this post, and it is there that Dr. Dutton died and is buried.

Kasongo was left on April 27, 1905. The journey thence to Pania Mutombo lay overland and was done on foot. Kalombe was reached on May 3, Maomedi on May 5. No stop of more than a day was made before reaching Tshofa (May 13 to 25). Four days, June 2 to 6, were passed at Cabinda. At Pania Mutombo (June 12) canoes were once more employed for the two days' journey down stream to Lusambo (June 5), where the expedition remained until July 8, 1905.

The journey from Lusambo to Leopoldville was done as quickly as possible by steamer, and no stops were made for work. At Leopoldville (July 21 to 30) arrangements were made for leaving Africa. The railroad between Leopoldville and Matadi was once more traversed, and on August 8, 1905, the expedition left the Congo Free State. On the way home Freetown, Sierra Leone, was visited for a week (August 16 to 22). Liverpool was reached on September 5, 1905; the expedition had been absent from England for just two years.

Other side-trips were made besides those mentioned; and it must be understood that when a stay of any duration was made in a post short journeys were always made in its neighbourhood.

As is shown by the map, the route followed by the expedition twice crossed the equator and traversed a territory lying between 2° North and 6° South of that line. The climates of the posts visited therefore varied somewhat. The succession of the seasons at the most important places is briefly as follows:—

At Boma the seasons are irregular. There is usually said to be a long and a short wet, and a long and a short dry, season. Practically, we may say that from May to September there is but very little—or no—rain; and that from October to the end of April there is a good deal; from January to April are the hottest months of the year. It is then, from October to May that conditions are the most favourable for the breeding of mosquitoes. At Leopoldville rain is more likely to fall in every month of the year than at Boma. From the 15th of June to the 1st of September is usually considered to be the dry season, and during this period there may be practically no rain.

Coquilhatville is almost on the equator, and consequently has no marked variation in its seasons. Rain falls in every month of the year, perhaps the most in November and December. The

temperature is constantly high, and during the first four months of the year it may be very hot. The climate is then admirably suited for the development of mosquitoes.

Bumba is one of the furthest north among the posts visited by the expedition. The seasons there are not well marked, rain falls in every month of the year; perhaps the least in January and February.

At Kasongo and Cabinda the seasons are much the same as at Boma, save that the "dry season" is shorter and rain often falls in August and May.*

When the expedition arrived at Boma the rainy season had already set in. For the first half of the month spent there, rain fell almost daily, the thermometer meanwhile varying between 85° and 70°F. During the latter two weeks there was an occasional shower or two and the temperature was slightly higher.

While at Matadi there was but little rain, so that but few of those places were seen where rain-water collects during the wet season to form breeding-places for mosquitoes.

When Leopoldville was reached the rainy season was well-established. The ground was sodden with water and the streams were filled to overflowing. From November to April rain fell almost daily, and there were frequent thunderstorms. The daily temperature varied from 70° to 89°F. In May less rain fell, and in June the "dry season," with its accompanying over-cast sky, evidently commenced, although there were still occasional thunderstorms.

On leaving Leopoldville practically no rain was met until the neighbourhood of Coquilhatville was reached. While the expedition was there rain fell almost every second day. One or two really hot days, maximum temperature 93° to 94°F, were encountered on the way up river. At Coquilhatville the temperature was much lower and exceedingly equable; this type of weather persisted during the journey up river, past Bumba and Basoko, to Stanley Falls. There

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*For general information concerning the climate of the Congo Free State we are indebted to a "Rapport sur le Climat, la constitution du sol et l'Hygiène de l'Etat Indèpendant du Congo" presented to the "Congrès national d'Hygiène et de Climatologie" at Brussels, Aug. 14, 1897, by Drs. Bourguignon, J. Cornet, G. Dryepondt, Ch. Firket, A. Lancaster and E. Meuleman. Thanks are also due to Dr. Etienne for copies of his meterological observations at Banana, and to Commandant Verdick for a copy of the observations made during 1904-05 at Kasongo.

were, however, one or two hot days (maximum 96°F), and while at the Falls there were a couple of severe thunderstorms.

From Stanley Falls the route lay south through the equatorial zone towards Kasongo where the rainy season had already set in. Frequent showers and thunderstorms were encountered on the way up river. The weather was pleasantly cool, the temperature varying usually between 82° and 71°F.

From November to April there was much rain at Kasongo (December, 216·3 mm.). The temperature meanwhile varied between 68° and 85°F. The march overland from Kasongo to Lusambo in May and June was made during the commencement of the dry season. Rain fell but rarely, the temperature became higher and its daily variation greater. Streams and swamps dried up rapidly, and by the end of the first week in May the prairie grass was often dry enough to burn.

Rain fell only twice during the stay of the expedition at Lusambo.

By referring to this synopsis of the weather encountered by the expedition the climatic conditions under which the insects, described in this report, were collected may be easily ascertained.

In the case of a post at which a long stay was made the month in which the specimen was obtained has been specified. To facilitate the finding of places in the map, the names of localities at which specimens were collected are always mentioned in the order in which they were visited.

A certain number of insects were sent to the expedition from places it left unvisited. In referring to these specimens the name of the collector and, when possible, the date of capture are given.

A considerable number of flies, collected in the British Colony of the Gambia* and in French Senegal, were taken, together with certain drawings and observations referring to them, to the British Museum on the return of the expedition of the Liverpool School of Tropical Medicine to Senegambia in July, 1903.

At the end of 1905 these insects had not been described by the British Museum authorities. It was therefore requested that they should be returned to the Liverpool School. While at the Museum, a considerable part of the collection had unfortunately been mislaid;

*For a map showing the localities mentioned in the Gambia, see Memoir XI of the Liverpool School of Tropical Medicine.

but a description of the remaining insects, which were returned to Liverpool, has been incorporated in this publication, with one or two exceptions, and these will be subsequently referred to as occasion may arise.

We desire to express our indebtedness and thanks to Mr. F. V. Theobald and Mr. E. E. Austen. for kind assistance rendered in the identification of the more obscure insects; and to Professor G. Neumann for the identification of the Ixodidae, and also for his valuable contribution to this group of the Arthropoda.

FAMILY CULICIDÆ

SUB-FAMILY ANOPHELINÆ

Pyretophorus costalis, Loew

Localities:—Zambie; Boma (Oct. 8 to 21); Prince's Island; Matadi (Oct. 29 to Nov. 25); Tumba; Wathen; Leopoldville (Dec. 10, 1903, to June 16, 1904); Telegraph post No. 4; Kitoto; Yumbie; above Lukolela in bush; Irebu; Coquilhatville; Bamamia; Lulongo; Nouvelle Anvers; Bokanga; Lisala; Bumba; Yambinga; below Basoko in bush; Stanley Falls; Benaburungu; Lokandu; Sendwe; Makula; Kasongo (Nov. 26, 1904, to Feb. 13, 1905); Tshofa; Lusambo; Lado enclave (Nov. Lemaire).

Circumstances of capture:—Imagines were taken in the day time and at night in the dwelling-places of Europeans and natives, in the mosquito nets of servants sleeping in the bush and, during the day time, far in the forest itself at a long distance from any village. Several were also caught in the evening about the table lamp on board our steamer.

Breeding places:—Pupae and larvae were found amongst the aquatic grasses growing along river edges, in swamps, in small clear puddles of rain-water lying on clayey soil, and in the foul-smelling pools used by the natives of the lower Congo for steeping manioc.

Field notes:—This is by far the most common Anopheline in the Congo. It seems to feed most fiercely just after sunset and again before dawn.

On two occasions during the stay of the expedition at Leopoldville it was necessary to work all night. On each occasion *P. costalis* was noticed to feed from dusk to about 11 p.m. From 11 p.m. to 3 a.m. none were seen. From 3 a.m. to

5 a.m. they fed fiercely, 15 or 20 insects attacked one at the same moment, and were able to feed successfully through clothing.

At Coquilhatville, early in the evening, these mosquitoes were seen flying into the houses of Europeans where ordinarily none could be found during the day time. The parasites of malaria were seen to develope in this mosquito at Boma.

In some of the mosquito breeding pools at Leopoldville the larvae of *P. costalis* were completely destroyed by larger, cannibalistic *Culex* larvae.

At Leopoldville in December, 1903, and in July, 1905, as well as at Ponthierville in October, 1904, it was observed that *Culicidae* were not breeding in the water of puddles and small streams containing an amorphous, brownish, apparently vegetable deposit,* although similar neighbouring collections of water contained many larvae.

Pyretophorus marshallii, Theobald

Six specimens, all females, were captured in the localities mentioned below. They were in all cases associated with *P. costalis*, but may readily be distinguished from the latter by the characteristic banding of the palpi. It is important to note, however, that among the long series of *P. costalis* there are many intervening forms between typical examples of the two species.

Localities:—Boma; Leopoldville (May); Coquilhatville; Yambinga.

Circumstances of capture:—The specimens were taken in the huts and mosquito nets of natives.

Myzomyia funesta, Giles

Localities:—Zambie; Prince's Island; Matadi; Wathen; Kalombe; Lusambo.

Circumstances of capture:—Examples of this mosquito were taken in the houses of both Europeans and Africans as well as in the mosquito nets of native servants. It is curious to note that not a single specimen of this mosquito was seen at Leopoldville where a careful mosquito survey was made.

Breeding places:—Examples of this species were obtained from larvae developed in the laboratory. It is probable that in the Lower Congo it breeds amongst aquatic grasses along the banks of rivers and in pools used for steeping manioc.

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* Possibly a species of *Crenothrix* on whose gelatinous sheath iron becomes deposited as ferric oxide.

Field notes:—Malaria parasites were seen to develope in these mosquitoes at Lusambo.

Myzorhynchus paludis, Theobald

Localities:—Leopoldville (Dec. 1903 to Feb. 1904); Bamu Island; Bamamia; Eala; Barumbu; Kumba; Kasongo (Dec.); Lusambo.

Circumstances of capture:—Imagines were caught in forests and marshes and in natives' huts. They also came on board the steamer in the evening after the lamps were lighted, and at Lusambo were caught about the lamps on three occasions.

Breeding places:—Adults were bred from larvae taken in marshes and in the stagnant and overgrown but fairly clean water left in pits from which clay had been taken for brick-making.

Myzorhynchus mauritianus, Grandpré

Localities:—Zambie; Boma; Leopoldville (Dec.); Bamu Island; Kasongo (Dec.).

Circumstances of capture:—Imagines were caught only in the forest at Bamu Island.

Breeding places:—Larvae and pupae were taken from among the grass along the edges of rivers, from swamps, from rain-water collected in puddles on clayey ground, and from stagnant, overgrown, but fairly clean, water left in pits from which clay had been taken for brick-making, and imagines were bred from them.

Cellia pharoensis, Theobald

Localities:—This mosquito was collected only at Boma. Specimens were caught in dwelling-places and some were also reared from larvae.

Breeding places:—Larvae were found amongst water-grasses growing along the river's edge, in swamps and in a dirty, muddy puddle

Field notes:—Malaria parasites were seen to develope in this mosquito at Boma.

SUB-FAMILY TOXORHYNCHITINÆ, Theobald

Toxorhynchites marshallii, Theobald

FEMALE.—*Head* scales bronzy-blue at the sides and between the eyes, bronzy-green on occiput, black along the nape. *Palpi* of four segments; sub-apical and apical segments minute; clothed with brilliant azure blue scales. *Antennae* black; first segment black at the base dorsally, grey at the apex with a patch of dull white scales; pubescence grey; hairs black. *Proboscis* azure blue. *Thorax:* Prothoracic lobes dull azure blue, with bronzy-green reflections; mesothorax black with brilliant bronzy-green scales; scutellar scales rich bronzy-yellow; and there are patches of the same coloured scales near the base of the wings; pleurae almost covered with dull white scales. *Abdomen* azure blue with rich violet reflections; penultimate segment with brilliant ruby reflections; anterior half of anal tuft black, the rest rich orange; there are white lateral spots to the first, second, third and fifth segments; venter blue with white scales on the fifth segment. *Legs* dark violet; coxae with some white scales; mid and hind femora dull bronzy-yellow beneath with white reflections, in some lights, and in the hind tibiae this colour extends to the upper surface on the inside; first segment of mid and hind tarsi with a dusky white band; second segment almost entirely white forming a distinct broad band; second tarsal segment to fore legs with an inconspicuous basal band of dusky white scales; fore, mid and hind ungues equal and simple.

Length 9 to 10 mm., exclusive of the proboscis.

A description of the ♀ has been given as it has not, apparently, been hitherto described.* Of the 22 specimens collected, only one is a male, the rest are all females.

Localities:—Tshumbiri and Coquilhatville.

Circumstances of capture:—Our thanks are due to the Rev. and Mrs. Billington, members of the American Baptist Missionary Union stationed at Tshumbiri, for a series of these mosquitoes collected in March, April, June and November. They have also supplied the following notes on the bionomics of these mosquitoes. "The adults fly with a characteristic loud humming; they were frequently caught in a European's house. The larvae were found in a metal water-tank."

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* Mono. Culicid., vol. 3, p. 121, 1903.

SUB-FAMILY CULICINÆ

Eretmapodites inornatus, n. sp. (Newstead)

(Pl. i, fig. 10)

Head clothed with brilliant silvery metallic scales with a patch of black ones in the centre. Thorax rich brown with two median, two short lateral, and a continuous marginal stripe of golden-yellow scales. Abdomen black; penultimate segment of the male with two lateral silvery spots; apical segment, in female only, almost entirely covered by silvery metallic scales; venter with five white metallic bands. Legs long, black with coppery or bronzy-brown reflections; no paddles to hind tarsi of ♂.

FEMALE.—Large basal median area of *head* clothed with flat black scales and a few isolated metallic silvery ones; upright forked scales black, rigid, occupying the dark area only; nape with a few narrow-curved, golden-yellow scales; lower third at the sides with flat black ones. *Palpi* densely clothed with black scales. *Proboscis* black with beautiful peacock-blue reflections. *Thorax:* Prothoracic lobes clothed with flat silvery scales except at base where they are black, there are also a few outstanding yellow scales and three long black bristles; mesothorax covered with dark brown and golden-yellow curved scales; the latter forming two median, two lateral and a continuous marginal stripe; the median stripes are short and curved downwards almost touching the marginal stripe; mid-lobe of scutellum with a long median patch of silvery metallic scales, bordered by narrow-curved, black ones; lateral lobes with a tuft or rosette of narrow-curved golden-yellow and a few black scales; metanotum with three black chaetae and three minute narrow-curved, golden-yellow scales (in type ♀); pleurae brownish-yellow or ochreous with a well-defined silvery line. *Abdomen* black, basal half bronzy-brown and black in some lights; penultimate segment with two lateral silvery spots; terminal segment silvery, tipped with black; venter black with five brilliant silvery bands and two lateral terminal silvery spots; the terminal band is interrupted in the centre by a narrow line of golden scales, which are continued into the succeeding segment where they form a rectangular basal patch. *Legs* black, bronzy-brown or peacock-green in some lights; tarsi paler; coxae ochreous; knee spots to posterior pair more conspicuous than in the anterior and mid pairs.

Wings clothed with dark brown scales, but in strong lights are of a beautifully bronzy peacock-blue and green.

Length 4·50 to 6·50 mm.

MALE.—*Head* as in the ♀ but the narrow-curved golden scales are more numerous and extend over the whole of the black median patch. *Thorax:* Prothoracic lobes and mesothorax as in the ♀; scutellum rubbed in both specimens, but there are traces of a similar decoration to that which is seen in the ♀; metanotum nude.* *Abdomen* slender, cylindrical; black with peacock-blue reflections; antepenultimate segment enormously dilated, with two large, lateral, silvery patches. Genitalia with the clasps of great length, and the slender basal segment densely clothed with hairs and scales; second segment with a long apical spine.

Length about 4 mm.

FIG. 1. *Eretmapodites inornatus.* WING OF FEMALE. × 40.

Distinguished from *E. quinquevittatus*, Theob., by the presence of narrow-curved golden-yellow head scales, and the absence of paddles to the hind tarsi of the ♂ besides other important details. Theobald makes no reference to the presence of chaetae and scales on the metanotum of *E. quinquevittatus* either in his monograph or in the Genera Insectorum, but they are quite evident in this species and also in *E. austenii*,† Theob.; at the same time they are not traceable in the males of either of these species, their absence may, however, be due to abrasions.

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* There is no trace of scales or chaetae in either of the two males which were collected.

† Mono. Culcidae, vol. 1, p. 283; this species awaits description.

Localities:—Coquilhatville; Lusambo.

Circumstances of capture:—Adults were caught only in the bush near water. On one occasion they were found in large numbers near a native village. They fed viciously at five in the afternoon; none of some 30 males and females caught at that hour appeared to have previously fed on blood.

Eretmapodites austenii, Theobald

Localities:—Coquilhatville; Stanley Falls; Kasongo.

Circumstances of capture:—Adults were twice caught in the afternoon in European houses. They were also taken in the "bush" near a native village placed on a small forest-covered island; they fed viciously at five in the afternoon.

Stegomyia fasciata, Fabricius

Localities:—Matadi; Wathen; Leopoldville (Dec., 1903); Sendwe; Kasongo (April); Tshofa; Lusambo.

Circumstances of capture:—Adults were caught during the day in the houses of Europeans.

Breeding places:—Adults were hatched in the laboratory from larvae and pupae taken from water collected in old pots and tins and from a foul-smelling pool used for steeping manioc.

Stegomyia argenteopunctata, Theobald

Localities:—Matadi; Kwamouth; Tshumbiri; Kisui.

Circumstances of capture:—Adults were caught only during the day time in the thick forest. At Kwamouth they were exceedingly numerous about a forest spring and bit viciously at mid-day. Those caught in a similar spot at about noon at Kisui did not attempt to feed. There were no huts within 250 yards of either of these places.

Breeding places:—A larva, allowed to develope in the laboratory, was taken from among the grasses along the river's edge at Matadi.

Stegomyia simpsoni, Theobald

Localities:—Matadi; Wathen; Leopoldville (Dec.); Tshumbiri; Kasongo.

Circumstances of capture:—Adults were taken, while feeding, in the houses of Europeans in the afternoon and at night (7.30 p.m., lamps lighted).

Breeding places:—Larvae were taken from water collected in old pots and tins and from a font containing holy water in a mission building. Imagines were bred from them.

Stegomyia luteocephala, n. sp. (Newstead)

(Pl. ii, fig. 5)

Head yellow. Palpi black with white tips. Thorax brown, with two large, anterior, lateral silvery spots, a median yellow stripe, and posterior lateral yellow spots; scutellum white. Abdomen black with pale narrow bands, terminal segments silvery. Legs black with silvery spots and white-banded tarsi.

FEMALE.—*Head* with the large central area thickly clothed with large, loose, flat yellow scales, gradually merging into smoky-yellow in front; a narrow silvery-white line to the anterior half of the eyes formed of a single series of broad, flat, closely appressed scales; between the marginal line and the central yellow patch is a broad band of brownish-black scales, from which, anteriorly, arise several upright forked scales; nape with a few long, thick, straight or slightly curved, pale golden scales, on either side of which is a group of upright-forked scales, intermixed black and yellow; lower basal portion with flat, dusky-white scales, the marginal ones forming two dull silvery spots, sharply divided by a dense black spot. *Antennae* black, nodes white; hairs black; pubescence grey. *Palpi* black; tips with long silvery-white scales. *Thorax*: Prothoracic lobes with flat silvery-white scales; mesothorax with a well-defined median line and two lateral spots of narrow-curved, golden-yellow scales; anteriorly there are also two large spots of flat silvery-white scales, and a few silvery-white scales on the lower margin of the posterior yellow spots; the rest of the mesothorax with rich dark brown scales; scutellum with flat silvery-white scales; pleurae dark brown with two large patches of silvery scales. *Abdomen* rich bronzy-brown; segments 1 to 6 each with a well-defined, narrow, basal band of smoky-yellow scales; penultimate segment with a large lateral patch, and the terminal segment almost covered with brilliant metallic-silvery scales; venter with well-defined more or less triangular patches of metallic-silvery scales narrowing towards the apex, where they appear as two divergent lines; the scales forming the outer lateral angles of the spots projecting at the sides of the abdomen appearing *as outstanding scales*. *Legs* bronzy

blackish-brown; coxae and trochanters, ochreous; anterior and mid femora with scattered metallic-silvery scales; hind femora with a central anterior band and an apical group of silvery scales; anterior and mid tarsi with narrow dull-white basal bands to the first three segments, metatarsal band broadest; hind tarsi with a broad white basal band to the first, a narrow one to the second, and the third segment almost entirely white above, basally it is not so. *Wings* uniformly pale brown rather densely scaled, first sub-marginal cell much longer and slightly narrower than the second posterior.

Locality:—A single specimen of this species was caught in the bush at Kumba.

Stegomyia albomarginata, n. sp. (Newstead)

(Pl. ii, fig. 4)

Head black, anterior margin white. Thorax grey-brown; pleurae grey. Abdomen dark brown with lateral grey angular spots to the fifth segment*; venter pure white. Legs pale bronzy-brown; femora white beneath; hind femora entirely so.

FEMALE.—*Head* with the flat scales uniformly olivaceous-black with dull bronzy reflections, with a well-defined continuous margin of white ones, broadening towards the base; there is also a napal patch of loose flat dusky-white scales. and below them a few narrow-curved, and very short upright forked ones; clypeus black. *Palpi* shining bronzy-black. *Proboscis* with bronzy-brown and ochreous scales, basal half with a median, interrupted, line of white scales. *Antennae* with the basal segment greyish-black, second segment pale brown, remaining segments darker; hairs dark brown or black, pubescence white. *Thorax:* Prothoracic lobes clothed with pure white scales; mesothoracic scales in front narrow-curved, white; at the sides from the base of the wings numerous flat, loose, white ones; dorsally the whole area is sparsely clothed with narrow-curved dark-brown scales intermixed at the sides and posteriorly with a few greyish ones; scutellar scales dull white, with a few shorter black ones at the base of the mid lobe, and also at the base of the marginal hairs to the lateral lobes. *Abdomen* with the first four segments brownish-black; a few dull white scales on the base of the fourth indicating the presence of a more or less imperfect basal band; venter uniformly

* Remaining segments wanting.

white as far as the end of the fourth segment; the remaining segments wanting. *Legs* with the coxae dusky brown, paler apically, with numerous flat white scales; scales to anterior and mid-femora smoky-brown above, ventrally they are white; hind femora clothed with white scales, except a narrow dorsal and a broad apical anterior patch of blackish scales; tibiae and tarsi of anterior and mid-tarsi blackish; posterior tibiae with a broad apical white band, tarsi wanting. *Wings* with dark bronzy-brown scales, those on the costa much the darkest, almost black; first submarginal cell much longer than the second posterior; posterior cross-vein nearly three times its length from the mid.

Length about 4 mm.

Locality:—Only two specimens of this species were caught, during the day, in a European's house at Kasongo (Dec.).

Scutomyia sugens, Wiedemann

Localities:—Matadi; Leopoldville (Dec. and March); Kisui.

Circumstances of capture:—Adults were caught in the bush at some distance from houses. They were seen to attempt to bite at mid-day.

Breeding places:—One adult was reared from a larva taken from a puddle on clayey ground containing clean rain-water.

Catageiomyia senegalensis, Theobald

A culicid with the habits of this mosquito was observed at Banana. No specimens were taken, but it is believed, from a hasty field examination, that they were referable to this species.

DUTTONIA, nov. gen. (Newstead)

FEMALE.—*Head* clothed principally with flat scales, with narrow-curved ones behind and a *row bordering the upper half of the eyes;* upright forked scales on the dorsal area. *Mesothorax* with small, narrow-curved, and minute hair-like scales; scutellum with flat scales, *the lateral lobes small, somewhat tuberculate, and furnished with eight bristles. Palpi* short. Fork cells long, almost equal; lateral vein scales long and narrow, but broadening towards the apex of the wing.

MALE.—With the anterior tarsi subchelate.

This genus is apparently related to *Aedimorphus* (Theobald), but differs in the presence of narrow-curved border scales to the eyes and the character of the lateral lobes to the scutellum. The number of bristles to the small lateral lobes are also unusual; and moreover there is a complete absence of flat scales* to the mesothorax.

Duttonia tarsalis, n. sp. (Newstead)

(Pl. ii, figs. 6-8)

Head grey. Thorax rich dull orange-brown with two median pale lines. Abdomen dark brown with silvery-white basal bands; apical segment almost entirely white. Legs pale ochreous-yellow, scales on tibiae and tarsi pale brown, femora faintly speckled.

MALE.—Lateral and median flat scales of the *head* dull white; the

FIG. 2.—*Duttonia tarsalis*. WING OF MALE. × 40.

narrow-curved ones bordering the eyes pale yellow; napal group of narrow-curved scales pale yellow, in some lights almost white; upright forked scales in front yellow, napal ones black, lateral ones yellow. *Palpi* of four segments, apically furnished with long hairs, pale ochreous with dark brown scales and indications of a faint median band. *Proboscis* dark brown. Segments of *antennae* dusky white; nodes dark brown; hairs silvery-grey and pale brown. *Thorax* deep rich orange-brown,† with a few scattered white scales, numerous minute, almost hair-like, jet black scales, and a few golden-yellow ones in front

* Theobald (Mono. Culicid., Vol. III, p. 290), in his description of the genus *Aedimorphus* says there are no flat scales on the thorax. In the type of *Ae. domesticus* the anterior white spots on the mesothorax are undoubtedly formed of small flat scales of the same size and character as those on the scutellum.

† One of four males has the thorax dark brown.

and towards the scutellum; the yellow scales also form two lateral spots in front of the wings; there are traces also of a lateral white line extending from the wings to the front of the mesothorax; scutellum with flat white scales; pleurae dull ochreous with patches of white scales. *Abdomen* very pale ochreous, with dark brown and dull ochreous scales intermixed; basal bands of pearly-white scales; bands 3 to 5 broader than the rest; terminal segment almost covered with pearly-white scales; venter pale ochreous with broad indefinite, basal, dusky-white bands. *Legs* pale ochreous, speckled throughout with ochreous-brown scales; anterior tarsi with the terminal segment subchelate; base considerably dilated, ventrally concave; base with four apparently bilateral spines, apex with a short curved spine, and immediately anterior to it a long plumose hair with a bulbous base; ungues subequal in length, the larger with a long central tooth, the smaller with a short basal tooth; mid-ungues unequal, the longest simple, the smallest with a central tooth; hind ungues approximately equal, simple. *Genital armature* with the basal segment of the claspers furnished with numerous long bristles, two of which, near the inner apical extremity, are narrowly lanceolate; second segment broadly dilated at the apex with an outer, curved, spine-like projection; terminal claw small, slender. *Wings* sparsely clothed with small brown scales; first forked vein narrower and slightly longer than the second posterior.

FEMALE.—*Head* dark brown; median flat scales smoky-brown, lower laterals forming a relatively large white patch; median narrow-curved ones yellowish-white, frontals white, marginal series to eyes pale yellow; upright forked scales numerous, apparently all black. *Antennae* very dark brown, with numerous minute, loose, flat, white scales, giving the segments a mealy appearance. *Palpi* pale brown with darker scales; tips with dusky white hairs. Clypeus very dark brown with minute, scattered, white scales like those on the antennae. Eyes yellowish-brown with two to three black spots. *Thorax* as in the ♀, but with a well-marked series of white scales in front of the mesothorax. *Legs* with patches of white scales on the coxae; underside of hind tibiae clothed with white scales, with a broad apical white band; the legs are also more uniformly coloured and browner than in the ♂, but the upper surface of the tibiae are speckled. *Abdomen* clothed with dark brown scales with paler ones at the articulations;

venter with lateral white spots; median area greyish.

Length 4·50 to 5 mm.

Taken in thick bush at noon, October 4th, 1904.

Locality:—Kisui.

Duttonia africana, n. sp. (Newstead)

Head with the palpi and proboscis black. Thorax dark brown in front, paler behind. Abdomen dark brown, paler at the articulations. Legs smoky-brown with pale knee spots; apex of hind tibiae with a white band.

FEMALE.—*Head* clothed principally with flat scales, median and frontal ones blackish, those at the side with dull bronzy reflections, below these there is a narrow curved band of bright ochreous ones,

FIG 3.—*Duttonia africana*. WING OF FEMALE. × 40.

which in some lights appear dusky yellow; there is a large patch of narrow-curved, dull yellow scales behind, and a single series of golden ones bordering the anterior half of the eyes; upright forked scales numerous and scattered over the whole of the dorsal area, black. *Antennae* dark brown; basal segment brownish-yellow at the apex, darker at the sides. *Palpi* short, black, and extremely hairy. *Proboscis* clothed with black scales. *Thorax* shining, rich, dark brown in front, paler behind; prothoracic lobes with large, white, narrow-curved scales and black bristles; mesonotum with minute, blackish, hair-like scales, and a few larger, narrow-curved, yellowish scales; there are also numerous black bristles at the sides and on the dorsum in the

region of the wings; scutellum trilobed; mid-lobe with small, flat, dark brown scales, and traces also of a few white ones; lateral lobes small, almost tuberculate, furnished with eight long bristles, and a patch of flat dull white scales. *Abdomen* clothed with dark brown and almost black scales; venter with broad, pale, basal bands interrupted by a median ochreous line which broadens towards the apex. *Legs* uniformly brownish-black; femora pale beneath; knees and tibio-tarsal articulations pale; hind tibiae with a broad apical white band. *Wings* with the first submarginal and second posterior cells about equal in length; posterior cross-vein about its own length distant from the mid.

Length about 5 mm.

Locality:—A single ♀ taken in a water-closet at Kasongo, April 7th, 1905.

Culex albitarsis, Theobald

Localities:—Boma; Kasongo (Feb.).

Circumstances of capture:—Adults were taken during the day in the open, and at night in a European's house.

Breeding places:—Larvae taken from swamps produced adults in captivity. The pupa of this mosquito is particularly large.

Culex annulioris, Theobald

All four specimens of this species were obtained from larvae caught in a grassy swamp near Leopoldville.

Culex dissimilis, Theobald

Specimens were caught in a tent near Tumba, October 26th, 1903.

Culex fatigans, Weidemann

Localities:—Boma; Matadi; Wathen; Leopoldville (Dec.); Mswata; Irebu; Coquilhatville; Bamamia; Lisala; Basoko; Stanley Falls; Kisui; Kasongo (Feb.).

Circumstances of capture:—Imagines were taken by day and by night in the dwelling-places and in the mosquito nets of both Europeans and negroes. They were also caught at noon on steamers

and in thick forest at some distance from any village. At night they were often seen on board the Expedition's steamer.

Breeding places:—Larvae and pupae were found breeding in old tins, in water reservoirs, amongst grass at the edges of rivers, in swamps and in the foul-smelling pools used for steeping manioc.

Field notes:—Enormous numbers of this mosquito, together with *Mansonia uniformis* and its var. *africanus*, were found during the day time in the prison at Bomba. They rested thickly clustered and motionless on the whitewashed walls of the cells, a few inches above a drain used as a urinal by the prisoners; scarcely any of these mosquitoes were seen on the neighbouring tarred portions of the wall. No breeding places existed within 200 yards of the prison.

Culex luteolateralis, Theobald

Localities:—Boma; Bamu Island; Kasongo (March); Lusambo.

Circumstances of capture.—Specimens of this beautiful little culex were caught in the early morning and afternoon, in the forest, in coffee plantations and in the houses and mosquito nets of native servants. They attempted to feed but rarely.

Breeding places:—Larvae were taken from amongst the grasses at the edges of rivers and from swamps. We were successful in obtaining imagines from them.

Culex metallicus, Theobald

Localities:—Miambwe; Lusambo.

Circumstances of capture:—Adults were taken in the bush, near marshy ground and at a few hundred yards from the nearest village.

Culex thalassius, Theobald

A single specimen of this species was obtained from a larva taken from a tub on the mission station at Wathen.

Culex tigripes, Grandpré

Localities:—Boma; Wathen; Leopoldville (Dec.); Tshumbiri; Yambinga; Kasongo (April to Feb.); Miambwe; Lusambo.

Circumstances of capture:—Imagines were caught in forests and marshes, during the day time on board the Expedition's steamer and at night in the houses of Europeans.

Breeding places:—Larvae and pupae, allowed to develope in the laboratory, were taken from among the grass at the edges of rivers, from swamps, from the foul water of stagnant puddles, from collections of rain-water in old tins, and from the foul-smelling pools used for steeping manioc.

This is evidently a variable species. None of the females agree with the typical form in the specific coloration of the head and thoracic scales. In the majority of the females, which agree best with Theobald's* description, the narrow-curved head scales are creamy-white in colour with, in some lights, a trace of pale yellow, especially in the frontal and large median ones; and the thoracic scales are smoky-brown with metallic reflections, almost golden in some lights, with the distribution of the yellow spots and lines as in the type. In addition to these variations, five of the females also possess a distinct median band to the proboscis and other distinctive characteristics. These forms are described below as a distinct variety.

Culex tigripes, var. *consimilis*, n. var. (Newstead)

FEMALE.—*Head* with the narrow-curved scales creamy-white, in some lights with a faint trace of yellow; upright forked scales black with smoky-grey tips; median hairs golden yellow. Thoracic scales chiefly of a greyish colour, with dark brown ones intermixed. *Proboscis* brownish-black *with a broad and well-defined median band* of pale ochreous scales; labella pale ochreous-brown. *Palpi* black or brownish-black with a patch of pale bright ochreous scales at the articulation of the first long segment; apex with dusky white scales. *Abdomen* dark brownish-black with scattered pale brown scales and narrow basal bands; basal segment with two median black apical spots; sixth and seventh segments with two lateral apical pale spots. *Legs* as in the typical forms.

Length 6·7 mm.

Localities:—Tshumbiri (July); Kasongo (Feb., April, May); Yambinga (Sept.); Miambwe; Leopoldville. The example from Leopoldville was bred from a larva procured in a grass swamp near the terminus of the railway. It is important to note that three females and four males of the more typical forms were bred from larvae obtained at the same time.

* Mono. Culicid. II, p. 34, 1901.

Culex viridis, Theobald

Localities:—Boma; Wathen; Leopoldville (Dec., 1903); Coquilhatville; Miambwe; Kasongo (Jan.); Lusambo.

Circumstances of capture:—Imagines were caught during the day in the bush, in the mosquito nets covering the beds of "boys," in houses of Europeans and Africans, and in the state rooms of a steamer on the Upper Congo.

Breeding places:—Larvae and pupae were taken from among the grass along the edges of rivers, in swamps, in dirty, foul-smelling collections of water, such as pools used for steeping manioc, and in water collected in old tins. Imagines were reared from these.

Field notes:—This mosquito has been repeatedly observed to have a distinctly green colour during life.

Culex laurenti, n. sp. (Newstead)

Head grey; thorax brown, abdomen paler; legs uniformly pale brown; venter and pleurae, pale, dull orange-brown; proboscis unbanded.

FEMALE.—*Head* with the narrow-curved scales pale silvery-yellow in front, the rest white; flat scales white; upright forked ones all black. *Antennae* dark brown, pubescence silvery-grey, in some lights with a faint yellow tinge. *Proboscis* clothed with brown scales, and towards the apex a few scattered, pale ochreous ones. *Palpi* very short; rich brownish-yellow; scales brown. *Thoracic* scales dull golden-yellow; pleurae with a few small groups of narrowly-rounded white scales, some of which are practically spindle-shaped. *Abdomen* uniformly pale brown. *Legs* uniformly brown above with pale brown scales, silvery-grey beneath, in some lights; coxae and trochantae rich brownish-yellow with dark brown scales; no knee spots and no bands to tarsi.

MALE.—*Head* scales as in the ♀. *Palpi* long, pale ochreous-brown with pale brown scales, apical segments dark brown densely clothed with long hairs. *Antennae* with silvery brown hairs. *Thorax* with a few white scales opposite the insertion of the wings; the rest, including the pleural scales, as in the ♀. *Legs* pale ochreous beneath, darker above, with pale brown scales; anterior and mid femora with white scales at the sides, posteriorly. *Abdomen* pale brown with

rather dark brown scales; segments 5, 6, 7 and 8 with a few lateral white scales; terminal segment with a broad apical band of creamy white scales; venter pale ochreous, scales pale brown and white intermixed. *Wing* scales dark brown on the basal half of the veins; apical portion with pale ochreous scales.

Locality:—Leopoldville (Oct. and Dec., 1903).

Two males and one female only were taken.

This species is dedicated to the memory of the Botanist, Professor Laurent, who died while on an expedition to the Congo Free State.

Culex par, n. sp. (Newstead)

(Pl. i, fig. 11)

Head and thorax grey. Abdomen dark brown; fifth and sixth segments with lateral pale spots; venter greyish, dark brown basally. Legs brown; femora and tibia freckled, the former much more so than the latter; anterior and mid tarsi with three narrow pale bands at the articulations. Proboscis with a broad median band.

FEMALE.—*Head* with the narrow-curved scales creamy-white; upright-forked ones pale ochreous, with a few very dark brown ones at the sides; flat scales few in number, creamy white. *Antennae* wanting. *Palpi* short; apical segment minute, clothed with dark brown scales. *Proboscis* dark bronzy-brown with a broad median creamy-white band; labella paler. *Thorax* dark brown; scales chiefly pale ochreous and creamy-white with a few black ones intermixed posteriorly and on the scutellum, the black ones predominate; there are also indications of four small equidistant black spots. *Abdomen* clothed with very dark brown almost black scales; a few isolated dull creamy-white ones on the first and second segment, a small lateral apical spot on the third, a large spot on the fourth and fifth; remaining segments rubbed; venter with a median pale line; last two segments with dull white basal bands, very pronounced on the penultimate segment; the remaining basal segments are not sufficiently clear to determine. *Legs* uniformly pale brown or ochreous-brown; knee spots faintly indicated; femora and tibiae with pale freckles; articulations of front and middle tarsi with three narrow pale bands; hind tibiae somewhat paler than the rest. *Wings* with pale and somewhat metallic-brown scales; fork cells

with their bases almost opposite; posterior cross-vein about one and a fourth times its length from the mid.

Allied to *C. thallasius* (Theobald), but differs in the absence of basal abdominal bands, the broader band to the proboscis, the predominating pale upright forked scales of the head, and also in the colour of the thoracic scales.

Locality:—A single ♀ taken at Tshumbiri on July 5.

Taeniorhynchus fuscopennatus, Theobald

This mosquito was caught only, near marshy ground, in the bush at Lusambo.

Taeniorhynchus annettii, Theobald

Localities:—Wathen; Coquilhatville; Kalombe; Lusambo.

Circumstances of capture:—This mosquito was only caught in the bush, and as a rule in the neighbourhood of marshy ground. Its larvae were not seen.

Taeniorhynchus aurites, Theobald

Localities:—Tumba; Tshumbiri; Irebu; Kalombe; Lusambo.

Circumstances of capture:—This mosquito was only caught in the bush, and as a rule in the neighbourhood of marshy ground. Its breeding places were not found.

Taeniorhynchus tenax, Theobald

Localities:—Boma; Leopoldville (Dec.); Lusambo.

Circumstances of capture:—Adults were caught in the bush near marshy ground.

Breeding places:—Larvae and pupae, collected from among the grasses at the edges of rivers and from swamps, produced imagines in the laboratory.

Mansonia uniformis, Theobald

Localities:—Boma; Prince's Island; Leopoldville (Dec., June); Bamu Island; Lulanga.

Circumstances of capture:—Adults were taken in the dwelling-places of Europeans and Africans, in the mosquito nets of "boys," and in the bush.

Breeding places:—Larvae of this mosquito were not seen.

Mansonia uniformis, var. africanus, Theobald

Localities:—Zambie; Boma; Prince's Island; Tumba; Wathen; Leopoldville (Dec. and May); Bamu Island (Jan.); Telegraph Post No. 4; Tshumbiri; Bolobo; Irebu; "in the bush above Lukolela"; Yumbie; Bamamia; Bumba; Basoko; Kama; Benaburungu; Nyangwe; Kasongo; Kalombe; Tshofa; Lusambo.

Circumstances of capture:—This species is by far the commonest mosquito in the Congo. It is seen almost everywhere in the bush, and lives equally well in grass country or forest. It always bites fiercely and feeds with equal readiness by day or by night. At Bamu Island, near Leopoldville, it was actually observed to pierce through canvas-seated chairs and even through the soft goat-skin leather of Madeira boots. It was noted in the diary of the Expedition as very unusual that no species of *Mansonia* were seen in the bush where camp was pitched for the night on the banks of the Congo a short distance above Lulonga.

Adults were caught in the houses of Europeans and Africans in the day time and at night. They were taken from mosquito nets covering the beds of natives and whites and were captured during the day on steamers, in the bush and on sand banks.

Breeding places:—We were not successful in rearing the imago from the numerous larvae we had from time to time in the laboratory.

Melanoconion rimus, Theobald

Localities:—Boma and Kasongo (Dec.).

Circumstances of capture:—The specimens in the collection were all bred from larvae.

Breeding places:—Larvae were taken from among the aquatic plants at the edges of a river and from a disused pit, in a brickyard, filled with water and overgrown with weeds.

SUB-FAMILY AEDEOMYINÆ

Aedeomyia squammipennis, Arribalzaga

Localities:—Boma; Leopoldville (Oct.)*; Yambinga.

Circumstances of capture:—The specimens in the collection were bred from larvae or caught in the evening on board a river steamer.

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* No specimen; recorded from field notes.

Breeding places:—Larvae were taken from a grass-grown puddle of clean water.

Uranotaenia balfouri, Theobald

A single ♀ of this beautiful species was bred at Kasongo, December, 1904, from a larva taken in an "old brick pool 15 feet across." Theobald* states that the mid lobe of his type was ribbed, in this specimen it is clothed with scales. It may be important to add that the scales at the base of the wing are of a delicate pale blue; but in certain lights appear white as described in the type.

Mimomyia uniformis, Theobald

This mosquito was observed only at Boma; the specimens in the collections were hatched in the laboratory from pupae collected in a papyrus marsh and from among aquatic plants at the edge of a river.

Field notes:—The pupae are yellow and possess very long and conspicuous respiratory siphons.

Mimomyia africana, n. sp. (Newstead)

(Pl. i, fig. 4)

Uniformly dark bronzy-brown; legs paler.

FEMALE.—*Head* very dark brown, completely covered with flat paler brown scales, no upright-forked ones visible. *Antennae* dusky ochreous, basal segment darker and not scaled. *Palpi* very short, clothed with very dark brown scales. *Proboscis* (imperfect) dark brown. *Thorax* very dark brown, slightly shiny, with numerous long bristles and minute narrow-curved scales, of the same colour as the cuticle; scutellum with a few narrow-curved scales; pleurae with a dark brown central area covered with creamy-white scales; metanotum nude. *Legs* uniformly dark brown, with paler coppery reflections, nodes pale brown. *Wings* with all the veins clothed with brown scales; fringe paler; first submarginal cell narrower than the second posterior cell; posterior cross-vein about its own length distant from the mid cross-vein.

Length about 3·50 mm.

Described from a single female which, unfortunately, has the abdomen and tip of the proboscis imperfect. Apart from this,

* First report Wellcome Research Laboratories, p. 82, pl. vi, fig. 6.

however, the insect possesses well-marked specific characters and can easily be recognised from any other known species by its uniform dark brown colour.

Locality:—Taken at Nouvelle Anvers, on August 14th, 1904.

Mimomyia malfeyti, n. sp. (Newstead)

(Pl. i, figs. 1-3)

Head dark brown, with pale ochreous scales. Thorax dark brown, with bright blue reflections and clothed with long backward-curved bristles; pleurae pale ochreous. Abdomen brown; apical segment paler; venter ochreous. Legs dark brown, with pale ochreous femora. Wings with a pale spot at the base.

FEMALE.—*Head* brown, covered with rather loose, flat, cream-coloured scales and a napal group of black, upright-forked ones. *Antennae* deep brown; basal segment paler. *Proboscis* swollen apically, but much less so than in the ♂, dark brown; labella, dull ochreous. *Thorax* dark brown, shining, *with blue reflections in*

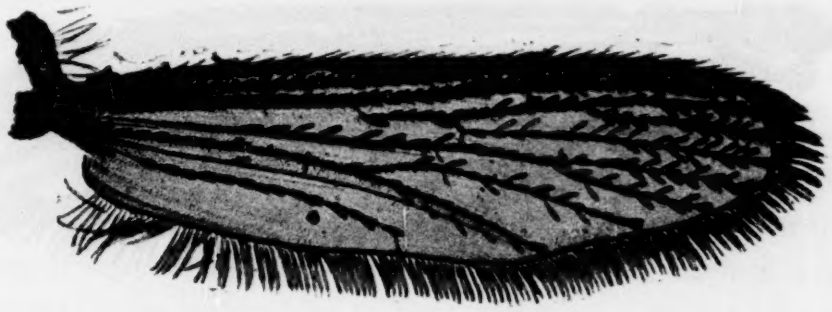

FIG 4.—*Mimomyia malfeyti*. WING OF FEMALE. × 40.

certain lights, but this character is much less evident under the microscope than under a pocket lens; hairs dense and long, especially at the sides above the pleurae; there are also one dorsal and two, more or less distinct, sub-dorsal rows of shorter hairs between which is a double series of *minute*, narrow-curved, ochreous scales, which are very difficult to see *and are often wanting*; scutellum with four or five narrow-curved, almost hair-like, black scales often wanting; metanotum pale brown, *nude*. *Wings* with brown scales and a basal, pale, nude patch; median vein scales *in a double row* on the subcostal and first longitudinal vein for two-thirds of the basal

portion; in single rows on the remaining veins; outstanding scales present on all but the sixth vein, but are most numerous on the apical half of the wing; first submarginal and second posterior cells about equal in length, the former slightly the narrower; posterior cross vein a little more than its own length distant from the mid cross vein. Halteres creamy; knobs clothed with flat brown scales. *Abdomen* unbanded, pale brown or ochreous, with somewhat scattered, flat, brown scales which give it a more or less mottled appearance; apical segment paler; venter ochreous, with four or five dark marginal triangular spots. *Legs* uniformly brown with pale reflections, except the ventral and basal half of the femora, which are pale ochreous; all the articulations are pale.

Length 2·50 mm.

MALE.—*Head* with dusky ochreous scales. *Thorax* as in the ♀; metanotum darker. *Antennae* densely plumose, dusky brown; basal segment paler. *Proboscis* much swollen from beyond the middle

FIG 5.—*Mimomyia malfeyti*. WING OF MALE. × 40.

apically; clothed with dusky ochreous scales; labella slightly darker. *Palpi* long, thin, apparently of three equal segments, tip reaching just beyond the base of the swollen portion of the proboscis. *Abdomen* as in the ♀ but if anything more distinctly mottled. Anterior tibiae with a long, outer, simple spine, and an inner, tridentate falcate spine. *Genital armature* with the basal segment stout; arising from its inner surface, at the base, are four long spinose hairs; second segment about equal in length to the first; terminal claw short; herpes relatively short, with one long and two minute spines.

Length 2 to 2·5 mm.

This species comes very near to *Mimomyia uniformis* (Theobald); but differs in the colour of the head scales, in the presence of a double row of vein scales to the costal and first longitudinal vein, and in the thorax with its regular series of bristles and bright blue reflections, and also the mottled appearance of the abdomen.

The peculiar proboscis and palpi of the ♂ are characteristic also of *Mimomyia uniformis*.

Locality:—This mosquito was observed only at Boma; the specimens in the collection were hatched in the laboratory from larvae taken in a grass-grown puddle of clean water.

This species is dedicated to Major Malfeyt, Haut Commissaire Royal, in recognition of constant courtesy and assistance rendered during the expedition.

POSITION UNCERTAIN

Neomelaniconion palpale*, n. sp. (Newstead)

(Pl. i, figs. 7-9)

Uniformly brown. Antennae densely plumose; hairs smoky-brown with the apical portions grey; segments clothed with minute white scales; nodes black.

MALE.—*Palpi* long, dark brown, with a few scattered blackish-brown scales; apex faintly clavate and densely clothed with long brown hairs, more especially so at the sides, where they form a long continuous fringe. *Proboscis* straight, pale brown, clothed with dark brown scales; apex extending to base of apical segment of antennae. Central area of *head* clothed with narrow-curved, pale golden-yellow scales, intermixed at the sides with long, flat, dusky-brown scales; sides with flat dark brown scales intermixed with a few yellow and dull cream-coloured ones; nape with a few small, upright-forked, black scales. *Mesothorax* (partly denuded) and scutellum with narrow-curved pale golden-yellow scales; metanotum nude; prothoracic lobes denuded; pleurae with small dull cream-coloured scales. Halteres pale ochreous basally, knobs pale brown, with a few small, flat, brownish scales. *Abdomen*, where denuded, almost black; scales pale brown with faint, dull, greenish-blue and dull coppery reflections; two well-defined sub-median, triangular, black spots at the base of the third

* Theobald, M.S.

segment, and there are traces of similar markings on the second and fourth; fifth and sixth, with a basal band of pale yellow; venter, at the base, with pale golden-yellow scales in the centre, dull creamy ones intermixed at the sides; the remaining segments are rendered invisible by the curved condition of the abdomen. *Wing* scales uniformly brown, darker on the costa; posterior cross-vein about one and a half times its length distant from the mid cross-vein; first submarginal cell scarcely longer than the second posterior, the latter with the veins widely divergent; outstanding scales long, narrow, sides parallel, apex convex; fringe scales long, lanceolate. *Legs* uniformly brown; posterior tibiae with a pale apical band; tarsi dark brown.

Length about 2·50 to 3 m. The specimen has the abdomen curved under, so that it is impossible to give the exact measurement.

Locality:—One male bred from a pupa taken in a pool on an island below Basoko, September 3, 1904.

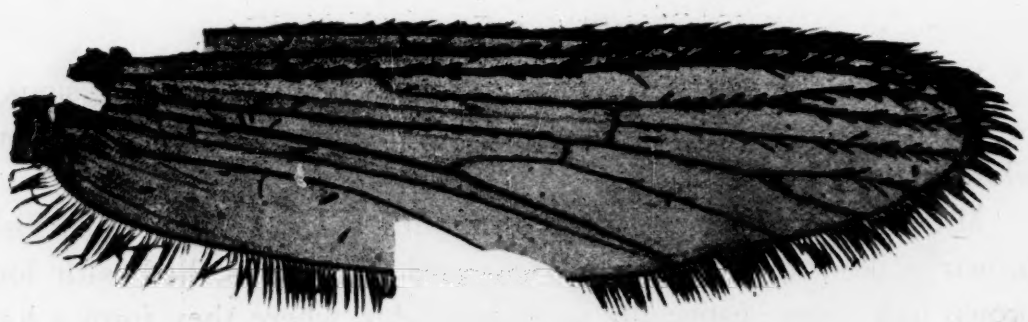

FIG. 6.—*Neomelaniconion palpale.* WING OF FEMALE. × 40.

Anisocheleomyia quadrimaculata, n. sp. (Newstead)

(Pl. i, figs. 5, 6)

Head pale brown with narrow ochreous margins. Antennae dusky. Proboscis swollen at tip; black with scattered bright ochreous scales; labella bright ochreous. Thorax bright ochreous with four black spots, the anterior pair being much the largest; behind the second and smaller pair is a large and somewhat ill-defined black band. Abdomen black with a dorsal series of elongated pale spots. Legs spotted and banded; femora dilated apically. Wings with scattered black scales, those along the costa forming a basal bar and two spots.

FEMALE.—*Head* with both black and pale cream-coloured upright-forked scales, the latter predominating; anterior portion with rather large, narrow-curved, bright fulvous scales, and apparently a few long flat ones, intermixed with the former are a few black ones tipped with bright fulvous; sides with flat, somewhat loose, cream-coloured scales. *Antennae* dusky brown; nodes pale. *Palpi* densely scaled, black, dorsally with white tips. *Proboscis* swollen apically; scales black intermixed with a few cream-coloured ones; swollen portion entirely black; labella bright ochreous. *Legs* with the anterior femora pale ochreous with a black apical patch in the centre of which is a distinct central crescentic band; mid and hind femora black, the former with two, the latter with one yellowish band; tibiae black, each with a sub-apical but somewhat diffused band; tarsi black with bronzy-brown reflections, each with five distinct yellowish bands; ungues equal, simple. *Wings* with bronzy-black and cream-coloured scales; basal half of costa with a long black bar and two irregular spots; all the nervures with irregular groups and isolated black scales; fringe pale; costal scales bronzy-black, becoming paler towards the apex; out-standing scales claviform; a few of the black ones, especially those on the sixth vein, heart-shaped. Halteres cream-coloured with dark brown scales at the tips. *Thorax* with narrow-curved, golden-yellow scales; four lateral spots of black ones, the anterior pair are the largest, and there is a broad indefinite band behind the second pair; scutellum with pale ochreous narrow-curved scales; metanotum black, with three dusky-yellow lines, and a basal, linear, patch of minute, flat, cream-coloured or white scales; prothoracic lobes and pleurae with flat, dull, cream-coloured scales. *Abdomen* clothed with black scales, having brownish coppery reflections; each segment with a long narrow median, basal, patch of dull cream-coloured scales; apical segment only with two lateral pale spots; venter ochreous.

Length 3·75 mm.

Locality:—Boma; bred from a larva which was caught in a marshy pool.

BOYCIA, nov. gen. (Newstead)

Head with a median area of narrow-curved scales, flat, loose, lateral ones, and numerous upright-forked ones. Thorax and

scutellum with narrow-curved scales. Wings with the fork cells relatively short; anterior forked vein slightly shorter than the first posterior; scales resembling those in *Mimomyia*. Palpi short in the ♀, long and clavate in the ♂. Proboscis swollen at the tip in both sexes. The narrow curved scales in the mid region of the head are fewer in the ♀ than in the ♂; and in the former the central ones are arranged in two distinct lines, but are almost completely hidden by the numerous upright-forked scales.

This genus is somewhat difficult to place, but agrees best with the group of Culcinae in which the palpi of the males are swollen at the tips.

Boycia mimomyiaformis, n. sp. (Newstead)

(Pl. ii, figs. 1-3)

Head greyish. Mesothorax grey-brown, with two anterior spots and a broad transverse band opposite the insertion of the wings, black. Abdomen black, with pale narrow basal bands; venter ochreous; pleurae pale ochreous. Legs brown; base of femora and tarsi (in certain lights) paler. Proboscis swollen towards the apex.

FEMALE.—Central area of *head* with narrow-curved, creamy-white scales, those in the centre forming two longitudinal series, intermixed with these are numerous creamy, upright forked ones, extending almost to the front of the head; sides with large, loose, spatulate, creamy scales; nape with numerous upright-forked, black scales; all the forked scales are broadly dilated with, usually, five well-marked dentitions. *Thorax* densely clothed with narrow-curved pale golden-yellow scales; two anterior spots and a broad transverse band of black ones; the band faintly constricted in front giving it, in some specimens, the appearance of two large confluent spots; scutellum with large, narrow-curved, creamy-white scales, those on the lateral lobes with golden reflections; metanotum nude*; pleurae creamy-yellow. *Abdomen* clothed with dark brown and black scales, appearing bronzy-purple in some lights, and narrow basal bands of pale ochreous scales; venter pale ochreous, with lateral, angular, dark brown, spots. *Legs* unbanded, bronzy-brown; femora pale ochreous-

* Two females show a single curved scale, but these are apparently loose ones from the metathorax.

brown at the apices, forming pale knee spots; tibio-tarsal articulations pale; last three segments of tarsi bronzy-ochreous.

Length 2·50 mm.

MALE.—*Head* with a well-defined median, long, angular patch of narrow-curved creamy scales, no regular series as in the female; sides broadly clothed with large, rather loose, flat, cream-coloured scales, and a rather large lateral patch of brown ones; a few short upright forked ones at the nape, black, and a few, very short, creamy ones towards the front of the head. *Antennae* densely plumose, hairs grey with a few black ones intermixed. *Palpi* strongly clavate, with a pale cream-coloured band at the anterior end of the first long segment; the remaining portion of the segment and the basal half of the succeeding one with very dark brown, almost black scales; apical

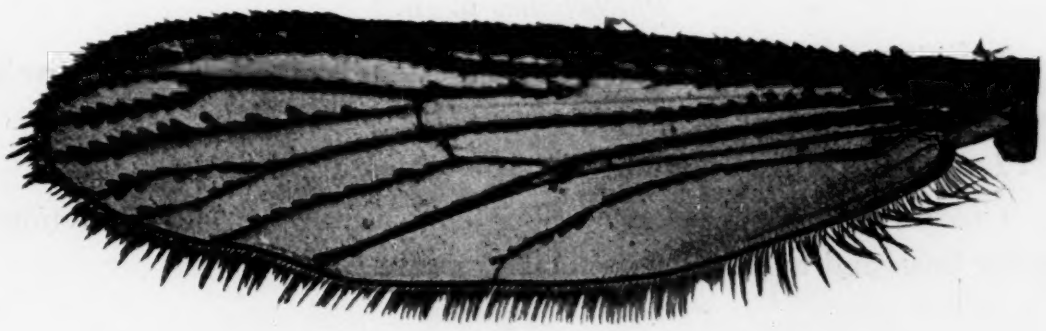

FIG. 7.—*Boycia mimomyiaformis*. WING OF FEMALE. × 40.

segment with short stiff yellow bristles. *Proboscis* swollen apically, dark brown; labella paler, especially at the tips. *Mesothorax* with the narrow-curved scales dusky yellow intermixed with grey and a few black ones, and there are two ill-defined lateral black spots in front of the wings; space between the wings denuded, dark brown; pleurae and legs as in the ♀. *Wings* with pale brown scales; anterior forked vein slightly shorter than the first posterior, the latter much the widest; both are relatively short. *Abdomen* as in the ♀ but the bands are a little more pronounced.

Localities:—All our specimens of this mosquito were bred from larvae caught at Boma (Oct.) in a papyrus swamp and among the aquatic plants of a small stream.

scutellum with narrow-curved scales. Wings with the fork cells relatively short; anterior forked vein slightly shorter than the first posterior; scales resembling those in *Mimomyia*. Palpi short in the ♀, long and clavate in the ♂. Proboscis swollen at the tip in both sexes. The narrow curved scales in the mid region of the head are fewer in the ♀ than in the ♂; and in the former the central ones are arranged in two distinct lines, but are almost completely hidden by the numerous upright-forked scales.

This genus is somewhat difficult to place, but agrees best with the group of Culcinae in which the palpi of the males are swollen at the tips.

Boycia mimomyiaformis, n. sp. (Newstead)

(Pl. ii, figs. 1-3)

Head greyish. Mesothorax grey-brown, with two anterior spots and a broad transverse band opposite the insertion of the wings, black. Abdomen black, with pale narrow basal bands; venter ochreous; pleurae pale ochreous. Legs brown; base of femora and tarsi (in certain lights) paler. Proboscis swollen towards the apex.

FEMALE.—Central area of *head* with narrow-curved, creamy-white scales, those in the centre forming two longitudinal series, intermixed with these are numerous creamy, upright forked ones, extending almost to the front of the head; sides with large, loose, spatulate, creamy scales; nape with numerous upright-forked, black scales; all the forked scales are broadly dilated with, usually, five well-marked dentitions. *Thorax* densely clothed with narrow-curved pale golden-yellow scales; two anterior spots and a broad transverse band of black ones; the band faintly constricted in front giving it, in some specimens, the appearance of two large confluent spots; scutellum with large, narrow-curved, creamy-white scales, those on the lateral lobes with golden reflections; metanotum nude*; pleurae creamy-yellow. *Abdomen* clothed with dark brown and black scales, appearing bronzy-purple in some lights, and narrow basal bands of pale ochreous scales; venter pale ochreous, with lateral, angular, dark brown, spots. *Legs* unbanded, bronzy-brown; femora pale ochreous-

* Two females show a single curved scale, but these are apparently loose ones from the metathorax.

brown at the apices, forming pale knee spots; tibio-tarsal articulations pale; last three segments of tarsi bronzy-ochreous.

Length 2·50 mm.

MALE.—*Head* with a well-defined median, long, angular patch of narrow-curved creamy scales, no regular series as in the female; sides broadly clothed with large, rather loose, flat, cream-coloured scales, and a rather large lateral patch of brown ones; a few short upright forked ones at the nape, black, and a few, very short, creamy ones towards the front of the head. *Antennae* densely plumose, hairs grey with a few black ones intermixed. *Palpi* strongly clavate, with a pale cream-coloured band at the anterior end of the first long segment; the remaining portion of the segment and the basal half of the succeeding one with very dark brown, almost black scales; apical

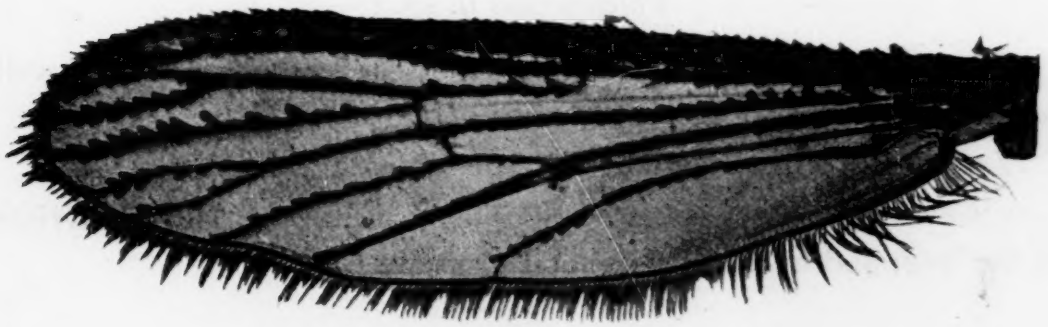

FIG. 7.—*Boycia mimomyiaformis*. WING OF FEMALE. × 40.

segment with short stiff yellow bristles. *Proboscis* swollen apically, dark brown; labella paler, especially at the tips. *Mesothorax* with the narrow-curved scales dusky yellow intermixed with grey and a few black ones, and there are two ill-defined lateral black spots in front of the wings; space between the wings denuded, dark brown; pleurae and legs as in the ♀. *Wings* with pale brown scales; anterior forked vein slightly shorter than the first posterior, the latter much the widest; both are relatively short. *Abdomen* as in the ♀ but the bands are a little more pronounced.

Localities:—All our specimens of this mosquito were bred from larvae caught at Boma (Oct.) in a papyrus swamp and among the aquatic plants of a small stream.

FAMILY CHIRONOMIDÆ

Ceratopogon sp. ?

This fly was only twice observed, once at Binza (Dec.), near Leopoldville, and again near Tumba. In these localities it was the most common bloodsucker observed. Although it is almost invisible its bite raises a large weal which itches for hours.

Chironomus sp. ?

The specimens which we obtained of this insect were bred from larvae, at first sight resembling mosquito larvae, caught in a swamp at Boma. This insect was also seen at Leopoldville.

FAMILY PSYCHODIDÆ

Phlebotomus n. sp. ?

The only specimens which we now possess are not sufficiently well preserved for descriptive purposes.

Localities:—Leopoldville (March); Wanie Numbu.

Circumstances of capture:—Specimens were taken in the daytime in the bush and in rest houses for Europeans.

FAMILY SIMULIDÆ

Simulium damnosum, Theobald

Localities:—Matadi; Lutete; Leopoldville (Nov.); near Miambwe.

Circumstances of capture:—Specimens of this species were caught both near, and at some distance from, water. They bite freely.

Simulium sp. ?

Localities:—Leopoldville (Nov., 1903, to Feb., 1904); M'Swata; Batikalela.

Circumstances of capture:—These flies were caught both near, and far from, water. They sometimes occur in swarms and are often found in houses. They bite freely, are persistent in their attacks, and when crushed emit a peculiar "bed-bug like" odour.

HABITS AND STRUCTURAL CHARACTERS OF THE LARVA OF SIMULIUM*

As the characteristics of the larvae of the European species of *Simulium* are not likely to differ very materially from their tropical relations the subjoined notes may prove of some guidance to students in other parts of the world. The notes refer to a single species, *Simulium ornatum*, Mg.

Shallow *rapid* streams *fully exposed to the sun* on hill sides, moors and open spaces in woods are the favourite resorts of these curious larvae. They are invariably found where the stream flows

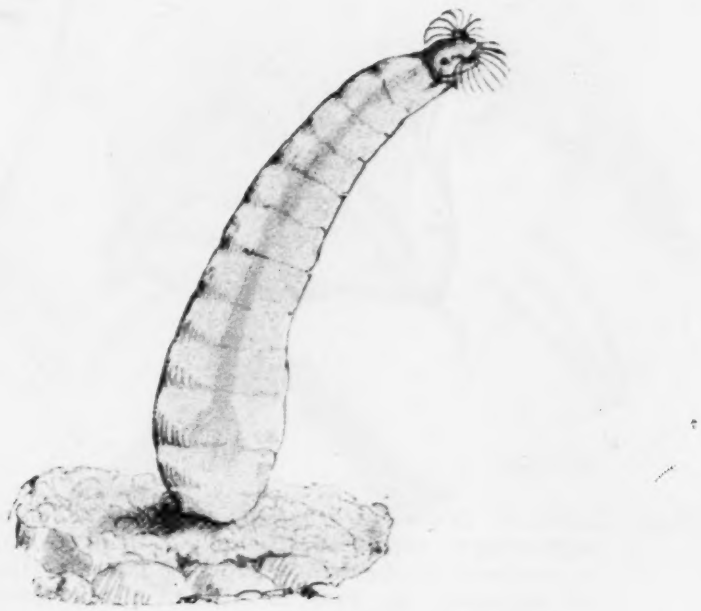

FIG 8.—LARVA OF *Simulium ornatum* in semi-erect position with the fan-like or fringed appendages expanded. × 6½.

most rapidly; never in the side pools or in comparatively still water; and very rarely in those portions of a stream which are overshadowed by trees or shrubs. In streams where all the necessary conditions are available the larvae sometimes occur in countless numbers, covering the *undersides* of nearly every submerged leaf or blade of grass, and also, where not too much overshadowed by aquatic plants, on the stones and fragments of rock at the bottom of the stream.

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* These notes were compiled from observations made in England and Belgium in the summer of 1906.—R.N.

When massed together on the stones and rocks they look at a short distance remarkably like a waving mass of dark brown or blackish algae or moss; but this resemblance is much less marked in colonies attached to the leaves and stems of plants.

The larva, when at rest, attaches itself to a fixed object by means of its anal sucker, standing in a semi-erect position (fig. 8) with its head pointing down stream; but in very rapid rivulets the body lies almost prone with the object upon which it rests, or the extremities may be brought together so that the body forms a distinct

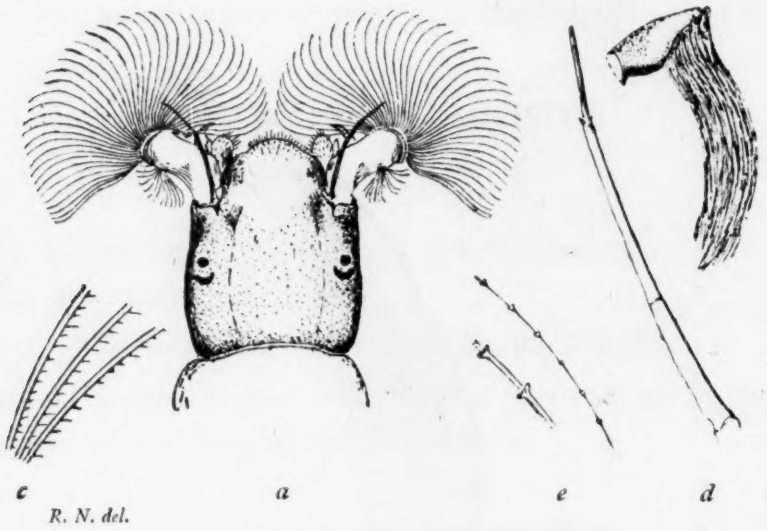

FIG 9.—LARVA OF *Simulium ornatum*:—*a*. head of larva with the fringed appendages expanded, × 49; *b*. fringed appendages closed; *c*. portions of the fringe showing lateral cilia, × 600, about; *d*. antenna, × 150, about; *e*. silken threads showing the characteristic nodes (enlarged).

loop. The head is provided with a pair of beautiful fan-like processes with which the animal sweeps the particles of food into its mouth. Unlike the larvae of mosquitoes they have little or no power of swimming, and when migrating from place to place, their method of progression strongly resembles that of the larvae or looper caterpillars of the geometrid moths. As they progress from place to place silken threads are spun in all directions, forming an irregular web or network along which they can travel with great ease. When forcibly dislodged from their resting places they immediately float down stream to distances varying from two to fourteen inches, suspending themselves by a slender silken thread, freshly spun, or by the network of threads

which may have already existed. Many of them will immediately commence to haul themselves back again by walking along the silken thread or threads, and this they accomplish by forming the body into a succession of loops, in the same way as they progress along stones and plants—the mouth or sucker feet grip the thread firmly while the posterior sucker is brought forward until it almost touches the anterior segments—the action being repeated until a place of safety is reached. Many, however, float down stream supporting themselves by their threads until some fixed object is reached. If a leaf or stem supporting a colony of larvae be pulled partly out of the water the larvae will all crawl back again to the stream and usually fix themselves to the submerged portions of the same leaf or stem.

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FIG 10.—LARVA OF *Simulium ornatum*:—*a*. maxilla and palpus; *b*. mandible; *c*. labrum; *d*. labial plate. × 125.

If placed in still water the larvae soon become sluggish and death takes place in about 17 hours, but if completely removed from the stream and kept in a thoroughly moist vessel they will survive for a much longer period.

When about to pupate the larva spins for itself a little elongated cocoon, shaped somewhat like the toe of a slipper, with a large opening at the broad end, and this is almost invariably placed with the opening pointing down stream. From this the head of the pupa, with its external respiratory filaments, projects and a sufficient supply of oxygen is thus obtained.

The period of pupation is only of a few days' duration: the minimum being two, the maximum six days. On bright sunny days they begin to hatch as early as 9 a.m. and continue to emerge during the heat of the day. A few examples also hatched in the laboratory during the night, but this was apparently an exception to the rule.

In order to rear the imagines the cocoons should be removed from the stream immediately they are formed; and the leaves and stones to which they are attached should be placed in glass jars covered with fine muslin or chiffon. All that is necessary is to keep the material perfectly moist; however, many imagines were successfully reared from pupae which had become perfectly dry. On no account should the pupae be left in standing water.

On the emergence of the imago the skin of the pupa splits along the median line of the thorax and the fly rapidly pushes itself forwards, being at the same time surrounded by air which gives it a greyish or silvery appearance, especially at the bases of the wings. The moment the insect has freed itself of the pupa case it is instantly carried to the surface when it grips the first object with which it comes in contact in its rapid course down stream, and having gained a foothold instantly takes to wing.* Occasionally the insects were seen completely immersed in the water, where they seemed at perfect ease either when walking along the stems of the plants or cleaning their legs and antennae. In such cases the wings were folded partly round the abdomen so that they tapered to a point behind, and in this way were seen to form a large air cavity. This remarkable trait was observed in still water only.

Description of the larva.—Body cylindrical, swollen posteriorly. Legs in two, coalescent, pairs; the anterior pair are attached to the first thoracic segment and project forward beneath the head and are provided with little hooklets; the second pair (fig. 11) are placed at the anal extremity and form a broad flat sucker which is surrounded by a band of hooklets arranged in regular transverse series.

Head (fig. 9, *a*) relatively large, elongated; labium broadly rounded in front. Eyes represented by two bilateral spots. Antennae (fig. 9, *d*)

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* Some species evidently dry their wings before taking flight.
Austen, 'Brit. Blood-sucking Flies,' p. 29 (1906).
Miall, 'Aquatic Insects,' p. 186.

slender, almost filiform, of apparently three segments, of which the first is extremely short, the second about half the length of the third. Immediately below the antennae is a large stout process furnished at the end with a long fan-like fringe of hairs, with a much smaller, but similar group of hairs arising from the centre of the lower lateral margins of the same process. The hairs forming the large fans are provided with an inner lateral fringe of delicate short hairs. *Mandibles* furnished at the tip with two stout and slightly curved spines and long silken hairs. *Maxillae* each with a long slender subterminal spine which is sometimes completely hidden in the dense tuft

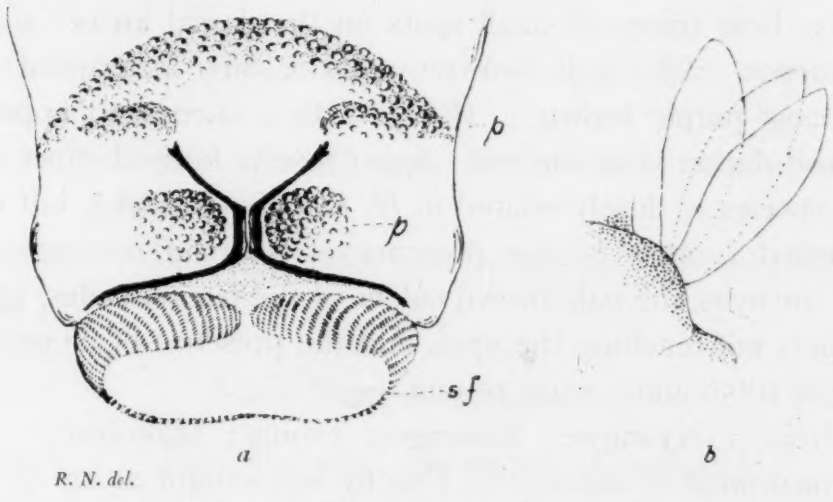


FIG 11.—LARVA of *Simulium ornatum:*—*a*. anal segment; *p*. papillae, *sf*. sucker foot with its coronet of hooks (× 45); *b*. anal appendages (× 45).

of silken hairs. *Antennae* short, stout, of two segments, the terminal one being about one-fifth the length of the first. Labial plate broad and angular; the anterior margin emarginate and furnished with nine strong teeth or spines, the outer teeth bidentate, the median tooth slightly the longest; anterior half of the lateral margins strongly serrate; and there is a submarginal row of long stiff bristles.

Length of fully matured larva 7·50 to 8·50 mm.

FAMILY TABANIDÆ

Hæmatopota duttoni, n. sp. (Newstead)

(Pl. iv, fig. 3)

Face dark brown, clothed with grey pubescence, with two black spots. *Palpi* dull yellowish-brown, sparsely clothed with black

pubescence above, grey at the sides. *Antennae* pale brown, tips black; first segment almost cylindrical, the third slightly longer than the first and second together. *Frontal callus* pale yellowish-brown, attaining the eyes, slightly produced in front; a broad rectangular spot of light rich chestnut between the eyes and a paler but ill-defined spot above it in the centre of the callus; paired spots large, black, and slightly reniform; unpaired spot distinct. No markings on the vertex. *Thorax* dark brown with three equidistant cinereous stripes. *Abdomen* brown, with golden pubescence; first and second segments with several rather large black spots; the remaining segments are spotted only at the sides with the exception of the two last ones, which also bear traces of small spots on the dorsal areas; scutellum dull cinereous. *Legs* pale brown; anterior tarsi and apical half of tibiae almost purple brown. *Wings* with a chequered appearance, apical third darker than the rest; upper rosette fairly distinct.

This species is closely related to *H. similis* (Ricardo), but may be distinguished from it by the presence of a broad rectangular spot between the eyes, the pale brown colour of the frontal callus, the large paired spots not reaching the eyes, and the presence of clypeal spots.

Length 10·50 mm.; wing 10 mm.

Localities:—Nyangwe; Kasongo; Tshofa; Miambwe.

Circumstances of capture:—This fly was caught along rivers and about cattle.

Hæmatopota trimaculata, n. sp. (Newstead)

(Pl. iv, fig. 2)

Head and thorax brownish-black; abdomen smoky-brown; legs black, tibiae dusky-white or pale ochreous; wings smoky-brown with three, equidistant, oblique dusky-white elongated spots.

FEMALE.—*Head:* Vertex with a deep triangular depression behind; uniformly black, shining. *Proboscis* and *palpi* brownish-black; pubescence greyish-black. *Thorax* finely punctate; dark brownish-black with two sub-median, obscure, narrow brownish streaks; transverse suture at the sides, and posterior angles paler than the rest; pubescence scanty, dusky-yellow. *Abdomen* smoky-brown, the last three segments darker; pubescence scanty, darker brown than that of the thorax; venter scarcely lighter than dorsum. *Legs* with the coxae and femora brown; anterior and hind tibiae ochreous-

white, apices dark brown; mid-tibiae entirely ochreous-white; tarsi black; first segment of posterior tarsi ochreous, the remaining segments brown-black; first segment of mid-tarsi pale at the basal half, the remainder brown, the other segments are wanting. *Wings* narrow, uniformly smoky-brown; with three costal dusky-white spots; the first, about midway between the base and apex of the wing, is placed below the costa and immediately above the first transverse vein; the second about midway between the first and third spots, forms a continuous oblique band extending from the costa to the base of the first forked vein; the third is slightly narrower and extends from the costa to the hind margin, leaving the extreme tip of smoky-brown.

Length 9 mm.; length of wing 8 mm.; greatest width of wing 2·75 mm.

A clearly distinct species, easily recognised by the curious coloration of the wings.

Locality:—Two specimens were caught in a European's house at Yakusu.

Hæmatopota brunnipennis, Ric.

Localities:—Coquilhatville; Nyangwe; Kasongo.

Circumstances of capture:—These flies were only caught on the river.

Hæmatopota spp.

Several rather worn specimens belonging to this genus were taken on cattle and horses at Matadi. Just to the north of the Limposo river one flew into the carriages of a moving train.

Chrysops dimidiatus, v. d. Wulp.

(Pl. iv, fig. 1)

Localities:—Banana (Dr. Etienne); Matadi; N'Kussu; Wathen; Tshumbiri; Lisala (reported by Rev. K. Smith); Yakusu.

Circumstances of capture:—Specimens were taken both near and at short distances from water. One was also caught in a European's house.

Atylotus nigromaculatus, Ric.

This fly was caught in a European house placed on high ground at the mouth of the Gambia River.

Tabanus canus, Karsch.

(Pl. iv, fig. 9)

Localities:—Lutete; Matadi; Lukolela; Ikelemba and Lopori rivers (March and Nov., Major Malfeyt).

Circumstances of capture:—This fly was only taken by persons travelling in canoes. It is reported to fly very rapidly and its bite is said to be very severe.

Tabanus dorsivitta, Walk.

(Pl. iv, fig. 4)

The only specimen we obtained was collected by the Rev. and Mrs. Billington at Tshumbiri.

Tabanus fasciatus, Fabr.

(Pl. iv, fig. 14)

This species is given to somewhat marked variation.

In several of the examples there is an entire absence of the apple-green colour on the abdomen and it is also of a more decided buff-yellow than is seen in the type. Other examples may be considered as transitional between *T. fasciatus* and the sub-species *niloticus*, Austen.

Localities:—Matadi; Leopoldville (Nov., Dec.); Lopori River (March, Major Malfeyt); Nouvelle Anvers; Tubila; Kasongo; Basongo; and at many places along the Gambia.

Circumstances of capture:—This insect was seen only near water. Most of the specimens were taken while travelling by steamer or in canoes. Two specimens were, however, caught in the houses of Europeans.

Field notes:—While living this fly is a very beautiful object. The eyes are a bright, metallic, pea-green, and the colours of the body are very much brighter than in dried specimens. It flies strongly, and is often seen on board steamers over 100 yards from the river's bank.

Tabanus gabonensis, Macq.

(Pl. iv, fig. 15)

Localities:—Lukolela (July, Rev. Whitehead); Ikelemba and Lopori rivers (March, Nov., Major Malfeyt); Baringa (July, Dr. Angela); Nouvelle Anvers (April, Dr. Müller).

Circumstances of capture:—Most of the specimens were taken by persons travelling on the rivers by steamer or in canoes.

Tabanus gratus, Loew

This species was caught in March, 1903, on the Kunchau Creek, about 175 miles up the Gambia River.

Tabanus par, Walk.

(Pl. iv, fig. 6)

A single specimen of this insect was caught on board a steamer plying on the Gambia River.

Tabanus pluto, Walk.

(Pl. iv, fig. 7)

This Tabanid was caught in the Congo near the river at Matadi and Kisantu.

Tabanus rufipes, Macq.

(Pl. iv, fig. 8).

Localities:—Matadi (?); Tshumbiri (April, Nov., Rev. Billington); Bolengi; Lulanga; Lisala; Stanley Falls; Wanie Numbu; Kasuku; Tshofa; Pania Mutombo; Lusambo.

Circumstances of capture:—This fly was caught only near water, usually while attempting to bite passengers in canoes or steamers.

Field notes:—They fly very rapidly and strongly, and have been seen at over 100 yards from the banks of the river. They seem to be very local. For example, near Pania Mutombo ten or a dozen were seen at the same moment darting about a canoe. A little further down the river towards Lusambo none were seen for miles.

Tabanus tarsalis, Adams

(Pl. iv, fig. 13)

This insect was only seen once, at Lutete.

Tabanus unimaculatus, Macq.

(Pl. iv, fig. 5)

One specimen of this fly was collected in November, 1903, at Matadi by Dr. Bourguignon.

Tabanus alboventralis, n. sp. (Newstead)

Thorax dark brown with three narrow lines; abdomen darker brown, with a bilateral series of oblique white spots. The whole of the ventral surface, including the head, white. Legs pale ochreous, with the tarsi and apices of the tibiae dark brown.

FEMALE.—*Head:* Space between the eyes ochreous-grey, with two broad transverse brown bands, the whole of the under-surface of the head, as well as the posterior surface, clothed with dense white pubescence. *Antennae* pale brown. *Palpi* pure white and wax-like. *Thorax* dull grey-brown, with a median and two sub-median greyish lines; margins grey, as well as the posterior margin of the scutellum. *Abdomen* dark brown, with narrow pale apical bands; the first to the fifth segment with a sub-median, oblique, elongated spot of greyish-white, the spots gradually diminish towards the posterior extremity, so that the last is scarcely visible, while that on the second segment extends right across the segment, terminating at the apical band; there is also a faint median line formed by patches of golden-yellow hairs; venter pale brownish clothed with white powder and pubescence, apical margins to all the segments with a distinct, narrow, ochreous border. *Legs* with the coxae, trochantae and femora white; tibiae pale ochreous with the apical third brown; tarsi all dark brown. *Wings* transparent, without markings.

Length 10 mm.; length of wing 8 mm.

Locality:—Caught during September and October, 1902, in the neighbourhood of Oyster Creek, near the mouth of the Gambia River.

It is closely allied to *T. obliquemaculatus* (Macq.), but Mr. A. E. Austen, to whom specimens were submitted, thinks that it is an undescribed species.

Tabanus billingtoni, n. sp. (Newstead)

(Pl. iii, fig. 1; Pl. iv, figs. 10-12)

Female black; margin of thorax and basal segment clothed with ochreous pubescence; second, third and fourth segments with a narrow pale apical band. Wings with a narrow median dark zigzag

line and a broad sub-apical band; apex with a clear triangular space; the anterior basal, and succeeding cell clearer than the rest. Male: Thorax red-brown, covered with grey dust. Abdomen black, with narrow grey bands to all the segments. Nervures of wing all margined with brown. Fore tibiae in both sexes white; the remaining segments blackish.

MALE.—*Head:* Eyes dull bronzy-brown (in dry specimen); ocelli ochreous; space between the eyes black, shining, brown below; clypeus and cheeks grey, the latter with long, silken, white pubescence; posterior surface of head dull grey. *Antennae* black, basal segment clothed with grey dust, the rest with ochreous-brown pubescence. Proboscis and labium black. *Thorax* in front of transverse suture, dull castaneous, with a narrow, faintly-indicated median line, and two narrower sub-median lines, which terminate in front as two black depressions; margins dusky greyish-brown; suture opposite the sub-median lines orange-brown, continued downwards as a short narrow streak; posterior half of thorax slightly darker than the anterior; the whole is covered with a greyish powder, and scanty black pubescence; scutellum and pleurae grey, but the latter are paler than the former. *Abdomen* smoky-black with narrow grey apical bands to the segments, these gradually diminish towards the apex, until they entirely disappear on the last one; venter of the same colour and banded as on the dorsum. *Legs* black; mid femora dark piceous; upper two-thirds of anterior tibiae dull white, the remaining third black. *Wings* with the nervures dark brown, all with a broad diffuse band of orange-brown surrounding them.

Length 16 mm.; length of wing 15 mm.

FEMALE.—*Head* as in the male, but the face is pale ochreous. *Thorax* rich dark brown, with two, narrow, sub-median pale fulvus lines which gradually darken and entirely disappear at the transverse suture; margins with a well-defined band of pale fulvus pubescence which is continued round the margin of the scutellum, and in front extends over the pleurae. *Abdomen* black, piceous in some lights, basal segment pale fulvus with the fringe of the pubescence paler; second, third and fourth segments with a conspicuous narrow grey apical band; venter with similar bands on the second to the fifth segments. *Legs* as in the male, but the anterior tibiae have the basal half only of a pale ochreous or dull white colour.

Length 17 to 20 mm.; length of wing 16 mm.; expanse of wing 34 to 35 mm.

Localities:—Several females of this species were first sent to us by Rev. and Mrs. Billington, from Tshumbiri. It has received its specific name as a mark of our appreciation of the interest shown in the work of the Expedition by the collectors. A female was also caught, near the river, at Bolengi. The only male we possess was sent to us by the Rev. M. Ave, from near Matadi.

It is an extremely well-marked insect, and is easily recognised from the other African species of *Tabanus* both by the banding of the abdomen and the markings of the wings.

Tabanus spp. incert.

Six additional species of this genus were taken in the localities named below; but the specimens have all suffered from mould and other injuries, so that it is impossible either to identify them with any certainty or to give adequate descriptions of them. One can only add that two of these specimens are referable to the *Socialis* group.

Localities:—Luano on the Kwilu River (Major Malfeyt, June, 1905); Matadi; Wathen, Leopoldville (Dec.); Lukolela (Rev. Whitehead, Aug.); Kuzu, in the region of the Lower Congo.

Circumstances of capture:—Two of the specimens were caught in a European's house.

FAMILY SARCOPHAGIDÆ

Sarcophaga spp.

Localities:—The representatives of this genus were collected at Leopoldville (Dec.); at Lokolengi on the Lopori river (Sept., Major Malfeyt); and at Kasongo (April); but the genus is a very widely distributed one throughout the Congo Free State.

Circumstances of capture:—Specimens were caught in the open and in privies. Adults were hatched in the laboratory from larvae brought by natives in mistake for larvae of *Auchmeromyia luteola*. Some species are viviparous, and their larvae are very rapidly deposited. Within a very few minutes freshly excreted faeces are often almost covered with them.

FAMILY MUSCIDÆ

Pycnosoma marginale, Wied.

Specimens of this beautiful species were collected only at Leopoldville.

Pycnosoma elara, Walk.

This fly was only observed at Leopoldville. The specimens were hatched from larvae brought by natives in mistake for the maggots of *Auchmeromyia luteola*.

Pycnosoma putorium, Wied.

Specimens of this insect were collected at Wathen. It was not seen in any other locality.

Pycnosoma sp. ?

The only specimen we possess is not in a sufficiently perfect condition for verification. It was captured, in company with others, at Tshumbiri.

Lucilia fuscina, Walk. ?

Localities:—Tshumbiri; Kutu; Basoko; Nya Lukemba (Jan., Dr. De Maria).

Circumstances of capture:—These flies were caught in the bush and were hatched from larvae found in the mud floor of a native hut. They are said to follow cattle.

Lucilia spp. ?

Several additional specimens of this genus were caught at Wathen and at Kutu (Feb.).

Auchmeromyia luteola, Fabr.

(Figs. 12-14)

Localities:—San Salvador; Noki; (Portuguese Congo, reported); Lukungu; Matadi; Wathen; Kimfuti; Leopoldville (Oct.-June); M'Swata; Tshumbiri; Lukolela; Irebu; Bikoro (Rev. Clark); Bamamia; Lisla; Upoto; Bongandanga (Rev. Gamman); Basoko; Loeka (reported); Yalembe; Yandongi; Romee; Yakusu; Stanley Falls; Wanie Numbu; Ponthierville; Kirundu; Utikakadjia; Kumba;

Lokandu; Sendwe; Nyangwe; Kasongo (Nov. to April); Molemba; Tshofa; Miambwe; Kabinda; Lusambo; Portuguese Angola (Bastian, interpreter at Lusambo); Lake Tchad (Monsieur Chevalier); ? Lagos (native reports); Sierra Leone (reported by Captain Grattan).

Circumstances of capture:—Most of the specimens were taken during the day time in or near the houses of natives and Europeans. One or two were caught at night as they buzzed loudly about a European's house.

Bionomics:—We have little to add to the description of the habits of this fly published in Memoir XIII of this School. The flies were again noticed to be attracted by the sleeping mats of natives. As before, the pupa usually took from a fortnight to three weeks to develop. The shortest period observed was ten days (temperature not unusually high).

The larva of this fly has already been described and figured*; but the mouth parts and stigmata need further elucidation to enable students to distinguish it from other allied species.

The great mouth hooks.—The anterior half of these organs is free, the remaining half subcutaneous; they are slightly falcate and bluntly pointed, the bases being emarginate, dorsally, with a clear nuclear space (? perforation) near the margin on the opposite side (fig. 12, *m.d. 2*). The *cephalo-pharyngeal sclerites* or processes (*c.s.*) for the first fifth of their entire length are of the same diameter as the mouth hooks, but at this point they suddenly dilate, forming a broad bifurcated plate; the lower or ventral half being broadest and longest with a deep posterior cleft. The *hypostomal sclerite* (*h.s.*), which lies between the anterior arms of the pharyngeal sclerites, is somewhat rectangular in shape, and resting upon it is a (? free) sclerite with three pairs of minute perforations; the anal angles of this plate carry a spine-like process.

External teeth.—There are three bilateral groups of these. The median pair (*c.t.*) are bidentate, and lie between the great mouth hooks; the anterior laterals (*p.s.*) form a distinct palmate group of nine stout teeth or spines; the posterior lateral groups (*p.s. 2*) are arranged in a similar way, but the outline is much more elongated

* First Interim Rep. of the Exped. to the Congo. Memoir XIII of the Liverpool School of Tropical Medicine.

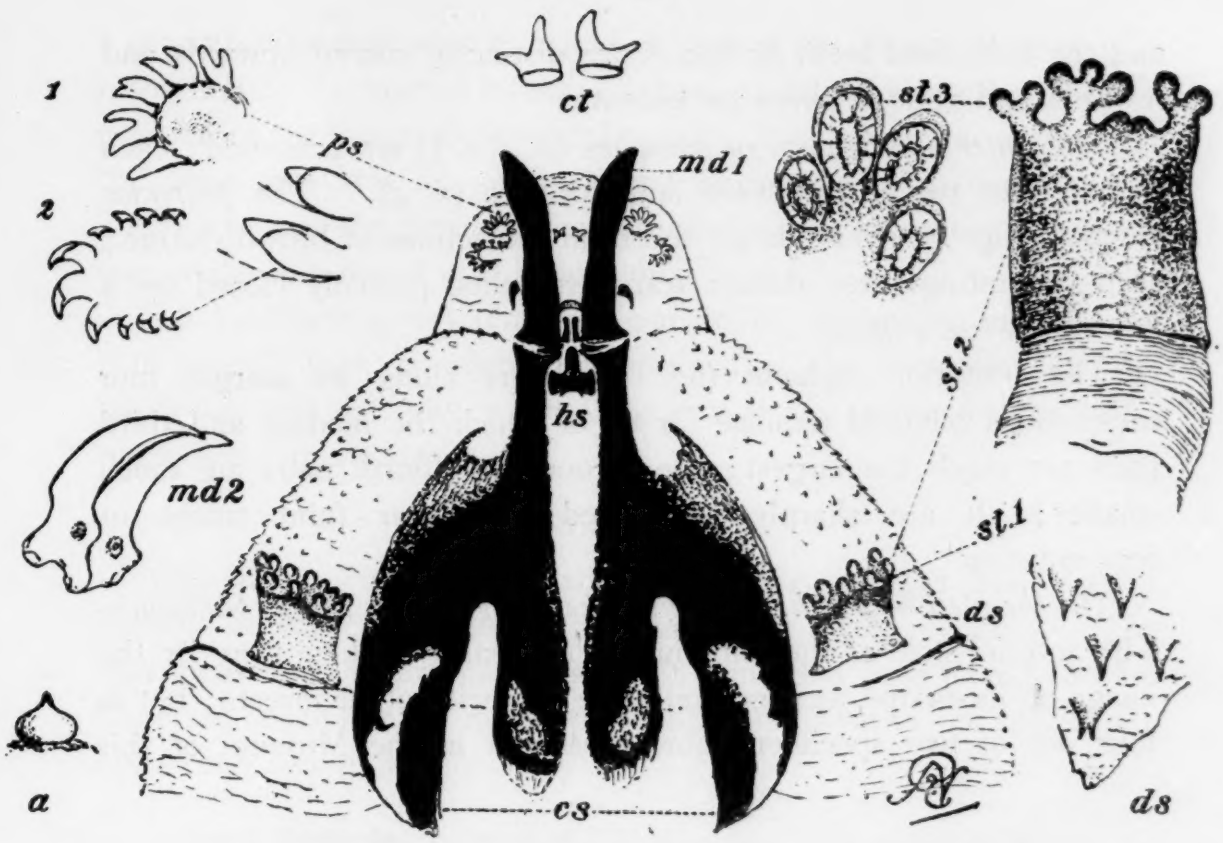


FIG 12.—*Auchmeromyia luteola* ("Congo Floor Maggot"). MOUTH PARTS, &c., OF LARVA :—*a*. tip of antenna : *md 1 and 2*. the great mouth hooks ; *cs*. cephalo-pharyngeal sclerites ; *hs*. hypostomal sclerite ; *ct*. central or median teeth ; *ps 1*. anterior-lateral palmate teeth ; *ps 2*. posterior-lateral teeth ; *st 1, 2, 3*. anterior or thoracic stigmata ; *ds*. dermal spines. (All greatly enlarged.)

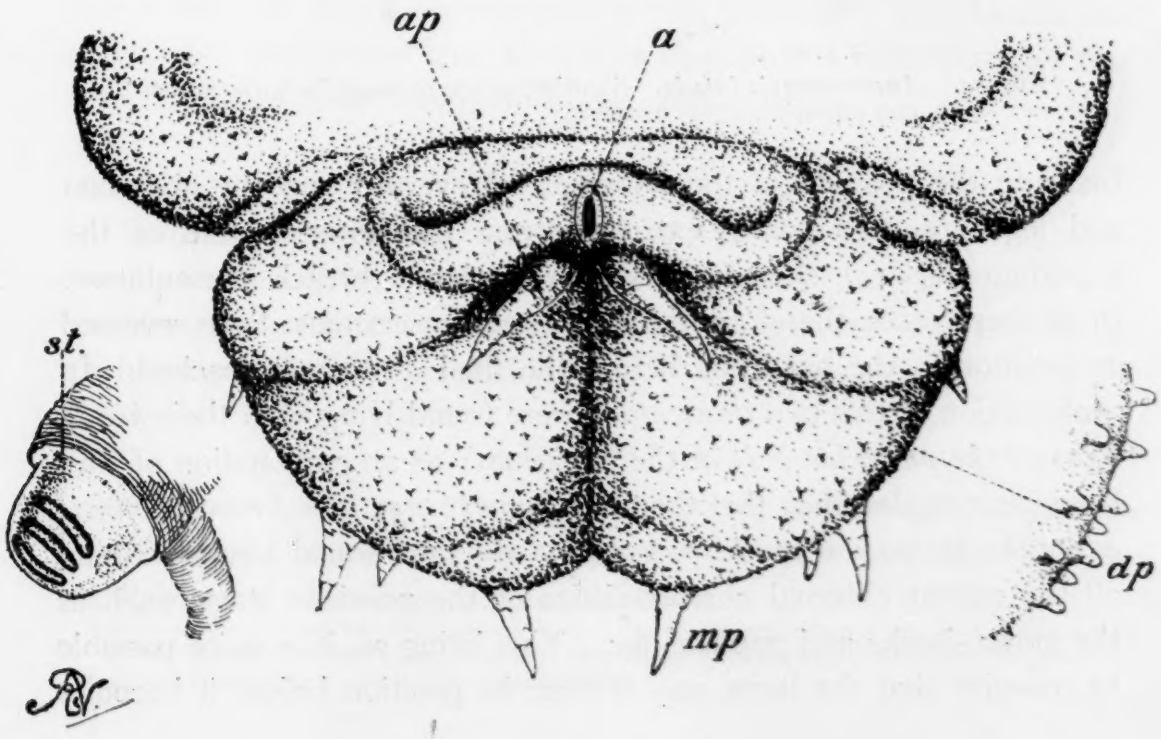


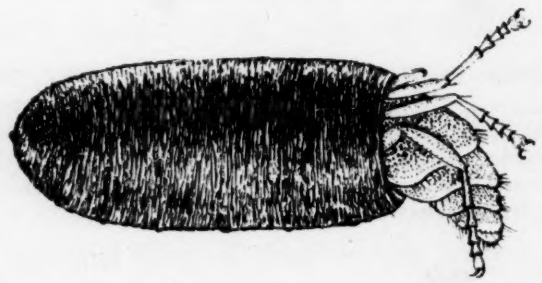
FIG 13.—*Auchmeromyia luteola*. ANAL SEGMENT OF LARVA :—*a*. anus ; *ap*. anal papillae ; *mp*. marginal papillae ; *dp*. dorsal papillae ; *st*. posterior stigmen. (All greatly enlarged.)

and the individual teeth or spines are distinctly curved upwards and inwards, and none of them are bidentate.

The *anterior* stigmata or spiracles (*st. 1, 2, 3*) are branched; each with ten to twelve relatively large orifices (*st. 3*). The *posterior* stigmata (fig. 13, *st.*) are large obconical projections of brown chitine; each presenting three darker transverse slits, partially closed by a fine transverse grating.

The posterior segment (fig. 13) bears along its margin four conspicuous bilateral papillae (*m.p.*), of which the median and third pairs are much the largest; the second and fourth pairs are much smaller; all are sharply attenuated and bear faint traces of segmentation.

On the method of the escape of the imago from the puparium.—The anterior pole of the puparium is invariably broken away by the imago on its escape, as is normally the case with other insects; but in four out of five specimens now preserved in the Museum of this



R. N. del

FIG. 14.—*Auchmeromyia luteola.* Showing escape of imago backwards from the puparium. × 7, about.

Institute the position of the imagines is reversed and the abdomen and legs are seen partly extruded from the anterior pole of the puparium (fig. 14), showing a very remarkable breach presentation. In all these cases, therefore, the imprisoned insect must have reversed its position in the puparium before the final instar was reached. In confirmation of this two pronymphs were found lying with their *heads against the posterior pole* of the puparium; as an explanation of this, however, one also finds that the *final larval stage is not reached until after the formation of the puparium:* the imprisoned larva retaining all the salient external characteristics of the previous stage, such as the mouth-hooks and papillae, &c. This being so, it is quite possible to conceive that the larva may reverse its position before it becomes

a propupa; though why it should do this is not clear. Neither is it possible with the limited material at hand to say whether the reversed position of the imago is abnormal or not. It is certain, however, that the pupa may also lie in its normal position with its head at the anterior pole of the puparium, as in dissecting out a number of puparia one imago was found in this position.

Thus we have a very remarkable anomaly; in the first instance the true larval stage is continued until after the formation of the puparium, and secondly, a large percentage of the flies escape backwards from the puparium.

Musca spp.

One species was taken on cattle at St. Louis, Senegal (May, 1903); another on cattle at Kasongo, and a third at Wanie Numbu. The specimens have, unfortunately, suffered somewhat from mould and are therefore unsuitable for descriptive purposes. Two of the species are apparently new to science.

A new Genus and Species of Blood-sucking Fly, allied to Musca

Several specimens of these interesting flies were caught on cattle and donkeys at St. Louis, Senegal, May, 1903, and also at Zambie on the Congo in September of the same year. All the specimens captured were forwarded to the British Museum in 1903 and 1904, and a series of five were returned to this Institute. Mr. Austen has given us to understand that he wishes to publish a description of this insect, and we await his publication* with interest.

Lyperosia minuta, Bezzi

Many specimens were caught on horses in a stable at Salikaine Creek, Gambia River.

Mr. E. E. Austen considers these as a new sub-species, having darker legs than the typical forms.

Lyperosia ? sp.

Specimens of a species allied to the above were caught on camels at St. Louis, Senegal, in May, 1903. We have not been able to identify these; but they are probably new.

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* Mr. Austen has now (Jan. 18, 1907) very kindly promised to publish the diagnosis of this insect in an early number of this publication.

GENUS GLOSSINA (TSETSE FLIES)

NATIVE NAMES.—Only occasionally did the names given below accurately specify the insects for which they were used. For example, the word designating "tsetse fly" meant often only "a fly of medium size which bites," and therefore the same term was sometimes employed without distinction for *Glossina*, *Tabanus*, *Haematopota*, and even *Stomoxys*. In the same way the words given for "floor maggot" sometimes signified almost any maggot or even "a crawling thing which bites." *Glossina palpalis* is by far the commonest tsetse in the Congo. The names given for "tsetse fly" were obtained from natives by showing specimens of it.

The various languages are mentioned in the order in which the tribes speaking them were visited. When names are given from places off the route of the expedition the name of the informant is mentioned.

The names of native places and tribes are spelled according to the usage of the Congo Free State publications. The names of parasites are written in accordance with the rules proposed by the Royal Society for the orthography of geographical names.

DISTRICT OF THE LOWER CONGO.

Bacongo language.

Tsetse fly	-	*mavekwa* (*vekua*)
Maggot	-	*m'vidi* (at Matadi); *n'tungwa* (at Wathen, is a general name for all maggots)
Maggot fly	-	*kuluyanzi*

TSHUMBIRI.

	Bateke language		Bobangi language
Tsetse	*eyibi* (S)	-	*eyiyi* (S)
	beyibi (P)	-	*biyiyi* (P)

Note these words signify almost any Tabanus or tsetse; they are further distinguished by *etsii* = small, or *enene* = large.

Maggot	*mozeu* (S)	-	*libinzu* (S)
	mezeu (P)	-	*mabinzu* (P)

IREBU.

Kundu language			Lusakani language
Tsetse	- *entune*	-	*vii*
Maggot	- *n'kisu*	-	*kisu*
Tabanus	- *ivovoko*		
			chelifer (also bed bug)—*silibonga*

LULONGA.

Elehu language

Tsetse	- *yiyi*
Maggots	- *mabinzu*
Maggot fly (*Auchmeromyia luteola*)	- *maboio*

UPOTO.

N'gombe language

Tsetse	- *ipokupoku*
Maggot	- *lutu*
Tabanus	- *eholoholo*
Chrysops	- *motuna*
Mosquito	- *ngungu*

BUMBA.

Bangala language			Language (?) men from Loeka (Itembiri river)
Tsetse	- *etuna*	-	*motoke*
Maggot	- *kiso*	-	*n'kusu*

BASOKO.

Language (?)

Tsetse - *difu* or *lifugu* (seems to be special name)

YAKUSU.

Keli language

Tsetse - *makuku* (also signifies Tabanus)

STANLEY FALLS.

Bagenia language			Bakumu language
Tsetse	- *kowowo*		
Maggot	- *kalombo* or *bio* (?) (At Taritubu general name for all maggots is *kiyo*)	-	*kusu*
Tabanus	- *dikuku*		

WANIE NUMBU.

Language (?)

Tsetse - *bungu* (*ngi* = any fly)
Mosquito - *m'bu*

People just below Wanie Numbu called *Glossina palpalis* '*kabobo*.'

KIRUNDU.

Swahili language (local dialect)

Tsetse - *chafua*

TO THE EAST OF THE CONGO RIVER AT LOWA.

Bujero language		Bakumu (?) or Babemo people
Tsetse -	*otjapara*, said to be specific -	*sumo* (S) *basumo* (P)

KUMBA.

Language (?)

Tsetse - *karboiboi*

KASONGO.

Swahili language (current trade language in the eastern part of the Congo Free State)		Bakusu language
Tsetse -	*kibou kidogo*, i.e., a small biting fly -	*mazanga*
Tabanus -	*kibou makubwa*, i.e., a large biting fly	
Stomoxys -	*ngi*, i.e., a fly	
Maggot -	*funza* or *funga* - - -	*lukusu*

Bango Bango language

Maggot - *kivinya*

KATANGA DISTRICT.

Language (?) (Dr. Ascenso and others)

Tsetse fly - *kisembe* (*kasembe*) *kasembele*

CABINDA.

Basonge language

Tsetse - *kiboua* (*lundo* at Miambwe); same name is used for Haematopota

Maggot - *kifinya*

LUSAMBO.

Baluba and Bakuba people present

Maggot - *kikusu* (S)
bukusu (P)

Basongomeno language

Tsetse - *bohembe*

ANGOLA DISTRICT.

Language (?) (Bastian, native interpreter at Lusambo)

Tsetse - *dibubulu* (S)
mabubulu (P)

Maggot - *dindwe* (S)
mandwe (P)

LADO ENCLAVE.

Miza language (Commandant Charles Lemaire)

Tsetse - *ewe*

IN THE NORTH OF THE FREE STATE.

Mangbetu		Azande (natives of these tribes)
Maggot	- *ngousu*	- *agbiti*

AT KOUSSOUR ON THE SCHARI RIVER NEAR LAKE TCHAD.

Maggot - *tadi*

Maggot fly - *acou*

This information was given by an intelligent lad in the service of the expedition led by Monsieur Chevalier.

Glossina palpalis, Rob.—Desv.

(Pl. iii, figs. 7-9)

Larva.—Orange-yellow; hood or anal segment black. Form somewhat cylindrical. Segments very pronounced; transversely wrinkled, and finely tesselated, the individual tesserae being flat and

shiny. Mouth hooks minute, contiguous and black. Anal segment or "hood" with the tumid lips deeply divided and widely separated.

When fully matured the larva almost completely fills the abdominal cavity of the parent, and lies with its posterior extremity ("black hood") towards the vaginal opening. A female which died while in the act of parturition has been preserved with the anterior extremity of the larva still attached to the vaginal orifice. This interesting phase in the bionomics of this tsetse fly is illustrated on Pl. iii, fig. 7.

Length 4·50 mm.; width 1·75 mm.

These measurements were taken from larvae laid by captive flies among whom abortion is frequent. These larvae may, therefore, not be quite fully matured.

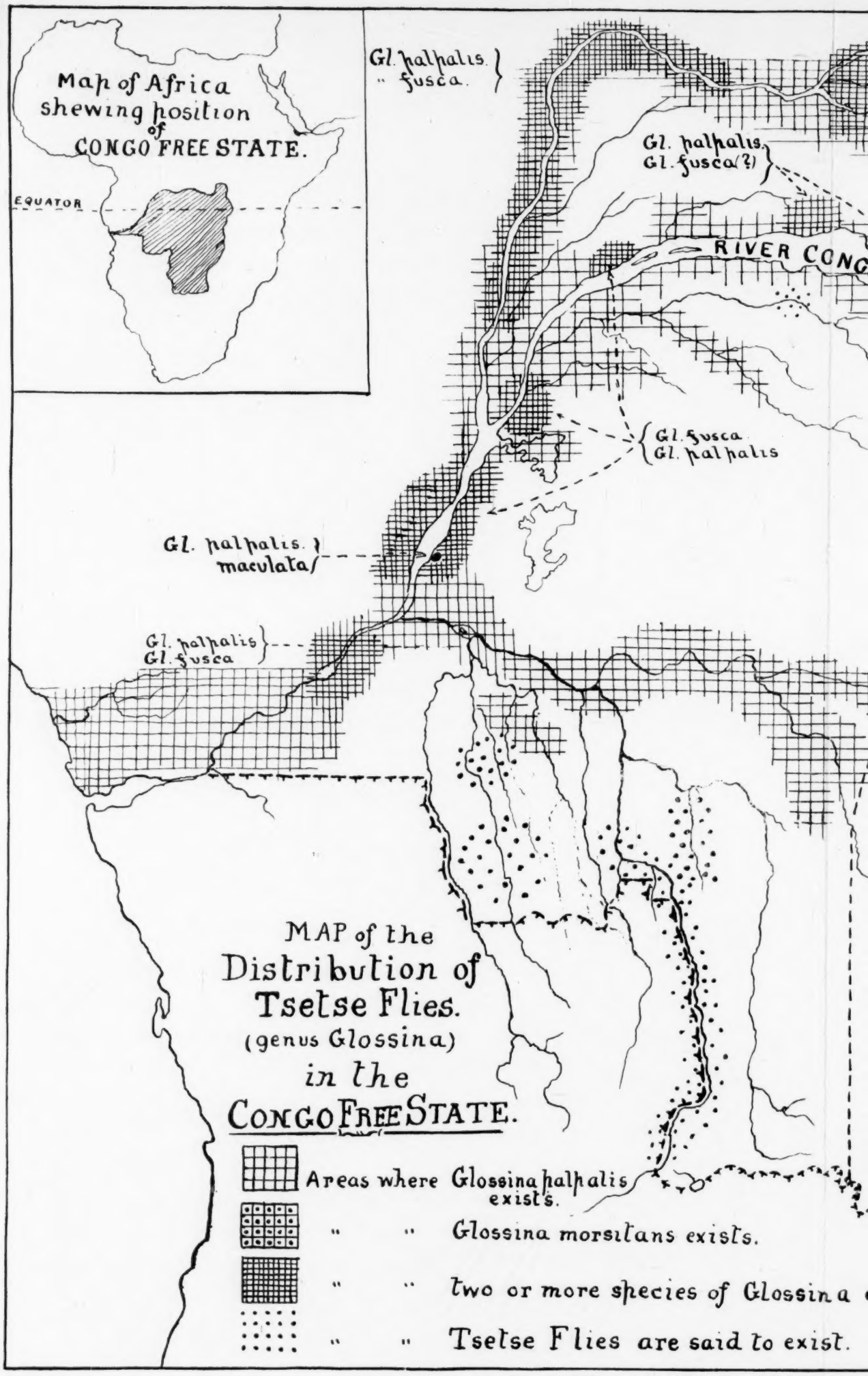
Pupa.—This agrees so well with the description given by Austen* that it is necessary only to call attention to the following details:—Colour, in a bright light, dull steel-blue, but traceable only in perfectly clean specimens. The tumid lips are divided to their bases and widely separated.

Length 5 to 5·75 mm.; width 3 mm.

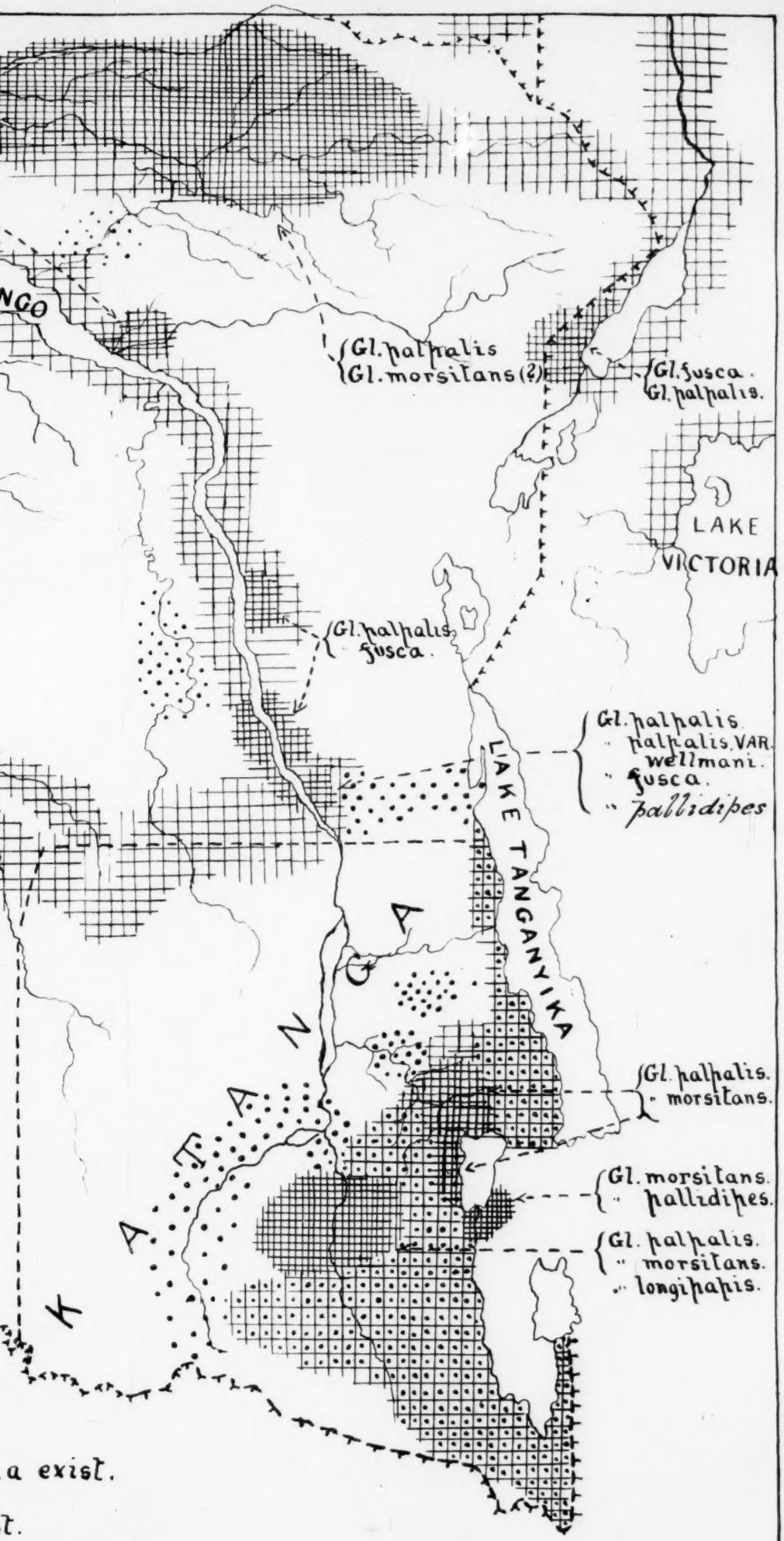
Localities:—Glossina palpalis is considered to be certainly present at the localities mentioned in the following list. Places at which specimens were obtained by the expedition are, as usual, simply mentioned. If the specimens were donated by friends their names and the date are given.

The names of several villages, from which no specimens have been obtained, appear on the list. *G. palpalis* is believed to have been present at them because of the proximity of places in which it has been seen and because of the evidence asserting its presence. The nature of this evidence is in every instance mentioned. It is indicated whether persons unacquainted with the name of the fly were shown specimens and *recognised* it as being present, or whether it was *reported* as present by those knowing its name. As a rule such evidence cannot be accepted as indicating more than the presence of a small tsetse (not *G. fusca* or *longipennis*). A second and supplementary list has therefore been prepared of places from whose neighbourhood specimens have not been received, at which "tsetse flies" have been reported to exist. In Map II the markings indicating the

* Monograph of the Tsetse Flies. Brit. Mus. Nat. Hist.; p. 26 (1903).



Map II (see pages


NGO
Gl. palpalis
Gl. morsitans (?)
Gl. fusca.
Gl. palpalis.
LAKE
VICTORIA
Gl. palpalis.
fusca.
Gl. palpalis.
" palpalis. VAR.
wellmani.
" fusca.
" pallidipes
LAKE TANGANYIKA
Gl. palpalis.
" morsitans.
Gl. morsitans.
" pallidipes.
Gl. palpalis.
" morsitans.
" longipalpis.
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distribution of *Glossina palpalis* are based upon the first list; those showing the distribution of undifferentiated species of "tsetse flies," partially depend upon the second list.

Banana (Oct., Dr. Etienne); Shiloango, Lukula and Lubengi Rivers (reported, June, 1905, de Laval); Banza Manteka (reported); Lufu River (reported, Rev. Morgan); Tumba; Wathen; Kuzu; Kisantu; Sabuka; Leopoldville (Nov., 1905, to July, 1905); Brazzaville; Bamu Island (Jan.-Feb.); Lisha (April, June, July, 1905); M'Swata; Kwamouth; Kitoto; Tshumbiri (seen ten miles inland, said to exist along all small streams of neighbourhood); Bolobo (recognised as present); Yumbi; Lukolela; Irebu; Bikoro (reported by natives and Rev. Clark); Bolengi; Coquilhatville; "All along Lulonga River to Baringa" (July, Dr. Angela); Ikelemba River (Nov., Major Malfeyt); Eala; Bamamia; "All along overland route from Boyembe to Lulonga" (July, reported, Rev. Gilchrist); Lulonga; Monsembe; Nouvelle Anvers; Bosesera (reported, Jan., Chef de Poste); Mobeka; Bokanga; Lisala, Bwela, Bosogodo (May, reported, Rev. K. Smith); "Along Congo from Lisala to Bumba and up the Itimbiri River" (reported, Dr. De Valkeneer); Bumba; Botsali; Yambinga; Bopamba; Basoko; Yalembe; Isangi; Yarbumbo (recognised by natives); Yandonge (recognised by natives); Yakusu (recognised by natives and Rev. Milman); Stanley Falls (recognised by natives); Katanga (recognised by natives); Batikalela; Wanie Bakula; Kewe; Wanie Numbu; Kisui; Ponthierville; Kirundu; Lalowa River; Utikakadjia; Lulindi River; Kumba; Kasuku; Maboka; Lokandu; Ukungwa; Kamimbi; Sendwe; Makula; Mfunkiva; Kibombo; Kundu River (Dec., reported, Commandant Verdick); Nyangwe; Salt Springs (Oct., reported, Monsieur Sappen); Kasongo (Oct. to May); East Bank of Lake Albert (April, Commandant Engh); Lado Enclave, 6° 33′ N., 29° 58′ E. (March, Commandant Lemaire); "*Glossina palpalis* is everywhere present in Uele, even in the smallest rivers" (Feb., 1906, reported, Dr. Hosselet); Kalombe (May, recognised by natives); Muadi River; Maomedi; Tshofa; Miambwe (recognised as present by natives); Kabinda; Kiambi; Katanga (Aug., Major Malfeyt); Pania Mutombo; Batampas; Lusambo (none at post itself, many along Lubi River, just opposite, and up and down Sankuru River); Lubefu; Basongo; Luano (Kwilu River, July, Major Malfeyt). There were but few *G. palpalis*

among the grass-covered islands of the Lower Kasai. They were, however, numerous in every patch of forest. In the Gambia (Sept., 1902, to April, 1903) *Glossina palpalis* was everywhere present along the river and its tributaries from its mouth to a point some fifty miles above Fatotenda.

Circumstances of capture:—On reviewing this list and comparing it with Maps I and II, it is apparent that *G. palpalis* is probably present in almost every part of the Congo Free State.

Tsetses were usually only found near water. If there be a fringe of forest or brush, perhaps 200 yards in breadth, along the water's edge, more flies will be seen by gently paddling in a canoe along the bank or by walking on the land side just at the edge of the belt of brush than by even a prolonged stay in the forest itself. The collection of water need not be large. *G. palpalis* and *fusca* have been caught along very small forest streams.

Their numbers were found to vary greatly in different localities. For example, along the Congo at Sabuka, near Coquilhatville, near Sendwe and near Kasongo, on the Lurimbi River at Tshofa, and at Batampas and Lubefu on the Kasai it was, as at many other places, almost impossible to avoid being bitten; but at Zambie, about the outskirts of Boma and Matadi, at Bolobo, Lisala, Romée and Stanley Falls, all places at which we believe *Glossina palpalis* to be present, not a single fly could be found. Careful search was made during our stay in each of these places, both by ourselves and by our fly-catching boys; it may be that we were unfortunate in visiting some of them on days when the flies were not visible, since it has been repeatedly noticed that the number of tsetse flies present in any locality may vary considerably from day to day without apparent cause.

On October 15th one member of our expedition left Maboka on the Upper Congo for Kaya. No tsetse flies were seen during the first half of the journey, and only one during the latter half. Ten days later the remaining members of the expedition travelled over the same piece of river and found large numbers of flies along the whole route. (See also Memoir XIII, Liverpool School of Tropical Medicine, page 106).

Again the flies may have been absent from some of the places named because they were comparatively free from brush along their water fronts.

It seems certain that the number of tsetses in the immediate neighbourhood of a post of any size may be considerably reduced if

all thick underbrush and rank grass, either near the water or a few hundred yards inland, be carefully removed.*

The station of Irebu, a military training post on the middle Congo, is beautifully kept. We remained there for three days and saw no tsetses, although there were many only a few hundred yards further up or down the river. A little over 1,000 yards outside the station was a trading factory placed in the middle of a patch of rank grass. *Glossina palpalis* existed there. Besides searching for tsetses on the station ourselves we sent out five boys trained to catch them, together with 60 soldiers. Between them all only a dozen specimens were taken. All were caught in a patch of rank grass, about 350 yards from the river, that had not been cut for two or three months. There were many scores of acres of cultivated land on the station, mostly consisting of well-kept, but shady, cocoa and coffee plantations. In them not one tsetse was found.

As Leopoldville developes and the surrounding brush is kept down tsetses become fewer, and we are told they are not nearly so numerous within the Protestant mission station as they formerly were. During our stay in Leopoldville *Glossina palpalis* was much more often caught in the house of the Rev. Mr. Morgan than in the building occupied by our expedition. The mission house was surrounded by a grove of palm trees which extended uninterruptedly to the river's edge, while the house of the expedition stood in an open piece of ground.

The experimental farm of the Government of the Congo Free State at Eala possibly may be considered to be an exception to this rule.

This farm is comparatively free from undergrowth. It is extensive and well kept, yet *Glossina palpalis* is quite frequently seen on it. There is a herd of 43 cattle and a fair amount of other live stock on the farm. It is believed that the flies are attracted by them.

It often happened, however, that no, or extremely few, tsetses were found, even after a careful search, in places where everything, shade, shelter and water, apparently favoured their presence.

Near Yambinga a search (of several hours), made on a bright day, along the thickly wooded banks of the main river of a small stream failed to find *Glossina palpalis*, although they were present in the near neighbourhood.

At Yakusu several hours in the middle of a fine dry day were spent in a canoe paddling along the banks of the river and about wooded islands. Tsetse flies were not seen.

The late Rev. W. Holman Bently told us that at a place called Vela in the Lower Congo *G. palpalis* was absent. The natives noticed this and decided that they were suffering from a want of the beneficent blood-letting enjoyed by their neighbours who lived in places where the fly existed. Men were therefore sent out to catch tsetses, bring them back and let them loose at Vela!

Behind the soldiers' lines at Lusambo runs a brush-covered stream which never

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* d'Aguiar. La maladie du sommeil et la tse-tse à Novo Redondo. Reports of the Fifteenth International Congress of Medicine at Lisbon, Fasicule 2, page 294. It is stated in this publication that *Glossina palpalis* is not seen in well-kept plantations nor at a higher altitude than 400 metres above the sea. This latter assertion is negatived by an observation of Commandant Charles Lemaire, who sent us specimens of the fly from the banks of the Ialo River (6° 33′ North; 29° 58′ East) caught at an altitude of 530 metres, and also by Lieutenant Brohez, who caught *Glossina* at an altitude of 1,600 metres, in places where the morning temperature went down to 0° C. (*loc. cit.*, *vide infra*).

goes dry, and in the wet season measures from ten to twenty yards in breadth. One could not imagine a place better-suited for tsetses; yet three competent observers (Dr. Broden, Dr. Polidori and J. L. T.) during a period of several months saw none there, although they were looked for many times. The observation might be explained by the fact that the stream is used as a latrine, and in hot weather reeks with effluvia. If this explanation be accepted it seems strange that *G. palpalis* has twice been seen in latrine sheds.

Tsetse flies will sometimes follow persons or animals for a considerable distance.

In the Lower Congo the belief that *G. palpalis* follows pigs is very common. We have not confirmed the observation. We are told that in the neighbourhood of Leopoldville *G. palpalis* was called by some of the natives "the pig fly" (Dr. Broden).

At Kilobala, a cattle station in the Lower Congo, it is definitely asserted that tsetses were formerly absent. Pigs were introduced, and with them appeared the flies! (?)

In the Gambia we lived for a time in a house placed almost a mile from the brackish water of a mangrove swamp where there were a good many *G. palpalis* Flies were twice carried into the house by persons who had just come over the road through the swamp. These were the only occasions that tsetses were seen about these buildings during a residence of three months.

At Lokandu on the Upper Congo, no tsetses had been seen about the house we used as a laboratory. Two tame antelopes were brought to be examined; two or three *G. palpalis* followed them.

Apart from these observations no information was gathered in the Congo to support the idea that tsetse flies are dependant on large game. On the contrary, many *G. palpalis* were seen in localities where there was exceedingly little game of any sort.

Apparently because of this habit tsetse flies were occasionally not seen at places where they were ordinarily present.

When the expedition reached the Lomami River, during the journey overland from Kasongo to Pania Mutombo, it employed some 300 porters. These natives reached the river first, and not a single tsetse was seen by the European members of the expedition during the hour and a half at midday spent in ferrying the caravan across the river. The flies were later frequently seen in large numbers at this spot at all times of the day.

It is probably for this reason that tsetse flies were not found at several of the small streams crossed near Kalombe, Dibwe, Miambwe and Lukola during the overland journey of the expedition. Search was usually made at the fords and bridges after a considerable number of porters had passed or while they were still present. The flies were not found in several instances, although the natives asserted their presence and although human trypanosomiasis existed locally. A search of one or two hours discovered tsetses at a couple of streams where they had at first seemed to be absent. At other water-courses a search during a like period was without result, and it seems possible therefore that *G. palpalis* only occurs in small numbers at the following places where human trypanosomiasis is frequent—the

percentage of resident natives having enlarged cervical glands without apparent cause is indicated—Kalombe (17 per cent.), Dibwe (18 per cent.), Miambwe (7 per cent.), Lokula (6 per cent.).

A proportion of the infected persons probably contracted their disease elsewhere. These villages have a considerable immigrant population ; they supply many carriers and a large proportion of their people are continually absent, collecting rubber, in the forest near rivers where tsetse flies are said to exist.

Had the flies been present in as large numbers as, for instance, at Kamimbi, it is quite inconceivable that the passage of even 300 men should have enticed them all away from their usual haunts.

The occasional presence of *G. palpalis* in places at a considerable distance from any collection of water may perhaps be explained by their habit of following animals.

In the Gambia, and again in the Congo, a single *G. palpalis* (?) has been seen on a dry plateau a couple of hundred feet above and about a mile distant from the nearest stream.

As would be surmised from what has already been said, *Glossina palpalis* is able to fly quickly and for comparatively long distances.

They are said to occasionally fly into the railway carriages as they pass near Palabala in the Lower Congo. They are frequently seen on steamers or canoes in mid-river, and distant 300 to 500 yards from either bank. On entering a moving vehicle the flies seek sheltered spots, and it is under the sunshade of the canoe or in corners of a cabin sheltered from the wind that they take refuge.

On one occasion in the Gambia a *G. palpalis* (?) persistently followed one of us (J. E. D.), who was riding rapidly on a bicycle, for several hundred yards.

At Tshofa, *G. palpalis* was frequently seen on the verandah of our house, although it was placed on high ground and at least two hundred feet above the river, which was about half a mile away.

Although *G. palpalis* has such extensive powers of flight, it seems to be very local in its habits. As has often been observed, not a single fly may be seen at 100 yards from a river although its banks swarm with them.

At M'Swata, however, *G. palpalis* was regularly seen along a little-frequented path on high ground and in open park country at a distance of 500 yards from the water and of 250 yards from the edge of the fringe of brush bordering the river. In partial explanation it should be stated that there was a good deal of game in the neighbourhood.

It has been often noticed that *G. palpalis* is most numerous at, and seems to lie in wait by, fords or frequented paths. Its habits have seemed to be more or less regular.

On one occasion, while resting by the side of a path, a *G. palpalis* was noticed to return on three occasions to the same spot on the sheltered under surface of a grass stalk after having been driven off by a native porter whom it was trying to bite.

Tsetse flies were practically never seen during rain and wind. They were most conspicuous and seemed most vivacious on bright,

warm days. In the cool of the early morning or on chilly days they were sluggish and were certainly much more easily captured; under these conditions tsetse flies have often been caught with the hand, ordinarily almost an impossibility.

Glossina palpalis is often seen in native villages and in the houses of Europeans living within a few yards of the river's edge.

The Rev. Mr. Morgan asserted that they most often entered his house on warm days. At Monsembe, on a cool morning (minimum temperature 71° F.) *G. palpalis*, so sluggish that they were caught between finger and thumb, were seen in the house of the resident European.

Field notes on the Bionomics of tsetse flies.—These notes are based on observations made on the captive flies, used during our attempts to transmit trypanosomes by their bites, and on flies seen in freedom during our stay in Africa.

When a tsetse prepares to feed* it spreads its legs, particularly the first pair, and so brings its whole body nearer its host; thus, as it were, "settling down to business." The palps are retracted until they form an angle of about 135 degrees with the bared proboscis There is occasionally a moment or two of hesitation before the proboscis is inserted. Ordinarily there is none and in a second or two the whole proboscis is buried to its bulb.

The proboscis seems very powerful and the flies easily pierce socks and ordinary white drill or duck clothes. They were, however, on more than one occasion seen to be quite unable to penetrate the tightly woven texture of a pair of riding breeches made of a patented cloth.

The penetration of the skin by their proboscis sometimes causes considerable pain. Occasionally it is unfelt.

Specimens of *G. palpalis* have frequently been watched filling themselves with blood from the backs and legs of unconscious paddlers.

While coming down the Kasai river, a small deck cabin was fitted up as a laboratory. Doors and windows were guarded by wire gauze, but through carelessness three tsetses had been allowed to enter the room. When they were found all were gorged with blood. The occupant (J. L. T.) had felt no bite. The weals, evidence that he had been bitten, soon appeared.

The proboscis, ordinarily completely inserted at the commencement of feeding, is usually withdrawn for a short distance just before the fly commences to visibly fill with blood. Often blood is not obtained on the first trial, and either the proboscis is withdrawn altogether and operations are commenced in a new place, or it is partially withdrawn to be re-inserted in, apparently, a new direction. The following observations will perhaps explain the way in which this

**G. palpalis* was watched with a pocket-lens while feeding.

may be done. It seems that *G. palpalis* flexes its proboscis in two distinct ways. The first, the more usual, is a sharp bending of the labella. Flies who had just fed were often seen, while preening themselves, to sharply flex their labella so that they stood out, almost at right angles, from the palps. The second movement was only seen in flies from whom the palps had been removed preparatory to dissection. In these the whole proboscis bowed until it described a well-marked curve directed ventrally. The second movement is probably due to the contraction of the powerful "tendons" lying in the labium.*

G. palpalis does not fill with blood so quickly as is usually imagined. The length of time between the insertion of the proboscis at the commencement of feeding and its withdrawal was noted in 25 flies carefully fed on an experimental animal. The greatest care was taken to avoid disturbing them. The longest fed for eleven minutes, the shortest for 1½ minutes, while the average was slightly over three minutes.

The extraordinary way in which tsetses distend themselves with blood is well known.

A female *G. fusca* was watched steadily filling itself with blood for six minutes. It was stopped feeding then lest it should burst itself. Its abdomen was so distended that there was a space of almost a millimetre between each of the dark coloured chitin plates on the dorsal surface of its abdomen.

In about a minute after feeding commences a drop of yellowish or brownish, opaque, but liquid faeces is extruded and a minute later—while still feeding—clear serum rolls, drop by drop, from the anus.

Sometimes tsetses who were plainly in need of food absolutely refused to attempt to feed. Others frantically probed animal after animal and failed to get blood. It has occasionally been thought that in captivity male flies did not seem to be so eager for blood as were the females.

In the cool of the early morning or evening *G. palpalis* is not nearly so voracious as at mid-day.

One is, however, occasionally surprised, as at Lubefu on the Kasai, in finding them active and biting freely early on a cold damp morning, or as at Kasongo and Lukolela in seeing them feed until dusk and fly actively about after dark. *G. palpalis* has twice been caught about the lamps at night.

These flies sometimes seem to prefer natives to Europeans, and dark to light coloured clothes. This first point is frequently commented on by Europeans travelling in canoes. They see that the native paddlers are worried by the flies while they are themselves often comparatively unmolested.

* Memoir XVIII of the Liverpool School of Tropical Medicine, page 53.

One day while coming down the Kasai the Captain, finding it cold, put on a blue cloth jacket. Many more tsetses were noted to settle on his coat than on the white duck suits of the European passengers and of the negro steersman.

The flies seem to find their hosts rather by sight than by smell, since in a given locality a moving person is usually more troubled by them than is one who sits still.

The persistency with which *Glossina palpalis* resumes its attacks despite slapping and brushing is very characteristic. As has already been stated, its flight is ordinarily rapid and darting. It is usually accompanied by a peculiar and characteristic buzzing. This fly can nevertheless, if it wishes, fly as noiselessly as an *Anopheles*. A fully gorged fly is exceedingly heavy on the wing, and usually flies only a yard or two before taking refuge in some quiet corner, where it quickly lightens itself by the rapid extrusion *per anum* of large quantities of colourless serum. Immediately after feeding the fly goes through an elaborate toilet and carefully cleans its proboscis. Sometimes just after feeding a drop of blood has been seen adhering to the outside of the proboscis at about its middle.

If a tsetse (*G. fusca* or *G. palpalis*) be held by its wings, or otherwise irritated, it can often be made to exude a tiny drop of clear fluid from the tip of its proboscis. Koch has made a similar observation.*

It has often been said that tsetses are frequently found in association with a particular tree or shrub. In the Congo two such plants were pointed out to us. One was a peculiar sort of palm, the other a variety of mimosa. Both grew on low-lying land along the river bank, and therefore were always seen where tsetses existed. Needless to say, the flies have been frequently seen in places where both were absent.

Certain reports to the expedition as well as the fact that *Glossina* was found to be absent from places apparently well suited to it have raised the question whether the numbers of tsetse flies present in a given locality may not vary very greatly through seasonal or other influences. No satisfactory answer has been obtained. The following observations are, however, interesting in this connection.

At Matadi and elsewhere in the Congo, as also in the Gambia, we were told that tsetse flies (*G. palpalis*) were much more numerous in the wet season. Lieutenant Brohez† asserts the contrary, and states that in Katanga they are more numerous and bite more fiercely in the dry season (*G. morsitans*, *G. longipalpis*, *G. palpalis* present).

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* Koch, Vorlaufige mitteilungen über die Ergebnisse einer Forschungsreise nach ostafrika; Deutsche medizinische wochenschrift, No. 47. Nov. 23, 1905.

† *loc. cit. infra.*

In April, just at the end of the dry season, a camp was made on the banks of the Upper Gambia river. *Glossina palpalis* was very numerous, but, strange to say, caused but little trouble ; there was a great deal of game in the neighbourhood.

It has been reported that certain localities were infested with tsetses which at an earlier period were free from them. These statements have not been substantiated, and they seem sometimes to have resulted from insufficient observation. The possibility of their accuracy must not, however, be forgotten, especially since it is frequently asserted that the area over which *Glossina* exists is widening.

Observations on captive Glossina palpalis.—During our attempts, in the Gambia,* to transmit trypanosomes by the bites of tsetse flies, we found that they would not feed well in small cages and died in the course of two to four weeks. It was thought that this might have been one of the reasons why our Gambian experiments had been unsuccessful, and when we recommenced our experiments in the Congo we determined to reproduce, as nearly as possible, the natural surroundings of the fly by keeping them out of doors in larger cages containing water and growing grass. Cubical cages of wire gauze measuring 18 inches along each side were employed. In each cage was placed from 20 to 70 flies. These larger cages were kept in a large mosquito house, measuring 13 by 8 by 9 feet, made of wire gauze. It was placed in a thick clump of bamboos, distant about 100 yards from the river. The flies were sheltered by the bamboos from the mid-day sun and, on two sides, from strong winds. Food was supplied to them by experimental animals, guinea-pigs and rats, which were immobilised and placed in the cages. *Glossina palpalis* certainly lived better under these conditions than they had done in smaller cages in the Gambia. They frequently lived for over 30 days ; 43 and 59 days were the longest lives noticed. In addition they seemed not to require food so often as had been necessary in the Gambia, and they were frequently left for 48 hours without an opportunity of feeding. This may be explained in part by their being out of doors and more exposed to cold and damp. Under such circumstances tsetses are certainly more sluggish in their movements.

The disadvantages of this method of keeping flies were however great. It was almost impossible in such large cages to count exactly the number of flies which had fed or to estimate the number present. They seemed to seek concealment and hid themselves in the smallest crevices. It was difficult to feed flies kept in this way on monkeys and the cages were too large to be easily transported.

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* Memoir XI, Liverpool School of Tropical Medicine.

In our experiments at Kasongo we therefore once more returned to the smaller cages. During our stay at Kasongo (Dec., 1904, to April, 1905) the average number of flies caught per day by each of the twelve members of our fly-catching gang was only about thirteen.* In spite of rewards for anything over twenty flies and punishment for anything under ten, the lads and men employed refused to exert themselves. Had they wished, each of them could have easily brought in thirty flies daily. Although it has been noticed that tsetses, *G. palpalis*, are far more "lively" at midday than on cool mornings, and although, on one or two occasions (at Leopoldville), particularly large numbers of flies have been brought in on warm days, the temperature seems to have had no marked influence on the number of flies caught by our boys at Kasongo. Most of the flies were caught on a small forest and brush-covered island about two miles down-stream from Kasongo. A few were caught along the river banks above and below Kasongo. All were taken between 7.30 a.m. and 4.30 p.m. The great majority of the flies captured were *Glossina palpalis*; among the 1,053 flies actually examined with a lens, only one *G. pallidipes* was seen. This was the only fly of this species we saw in the Congo. About a score in all of *G. fusca* were taken at Kasongo. There was no preponderance of either sex among the flies caught.

The method employed in taking the flies was as follows. Each negro was provided with a short-handled, deeply-bagged "butterfly" net. When the tsetse, in attempting to bite, alighted on the natives' bare legs the net was whisked by and the fly was usually caught. It was then transferred to a dry, dark-coloured bottle; they were thus protected from sun and wind and lived much better than in small wire gauze cages. Flies collected in white glass bottles were invariably killed by the sun in a very few hours, while on several occasions strong winds have seemed to be very destructive to flies in cages. On arriving at the laboratory the flies were transferred to three-sided wire gauze cages from six to ten inches in length, with sides four inches in width. The bottom was made of wire gauze and the top was closed with white cotton cloth and a purse string gathering. As many as 70 flies were occasionally placed in one of

* The average number of flies caught by the fly-catching "gang" at Leopoldville (Nov., 1904, to Jan., 1905) was only slightly better than this.

the largest of these cages. The usual number was about 30, often less. No water was placed in the cages and they were simply hung in a sheltered, shaded corner of the laboratory, out of the way of ants; on one occasion several hundred flies were practically all killed in one night by small red ants.

Under such conditions the mortality amongst the flies, though well fed, was very great. Especially was it so during the first few days in captivity before they seemed to have realised that they were caged. They continually dashed themselves against the wire gauze and in a very few hours had frayed their wings to mere stumps or occasionally had even lost a leg or two. As they became accustomed to their surroundings they became much quieter, barely moving for hours together, and the death-rate diminished.

Thus, about 32 per cent. of the flies died during the first 24 hours, 11 per cent. during the eleventh 24 hours, but only 9 per cent. during the seventeenth.

One fly, from a batch of 19, lived under these conditions for 38 days. Many lived for from 20 to 28 days. It has been thought that perhaps the males live longest in captivity. The frequency with which gravid female flies aborted soon after entering the cages was very noticeable. Also remarkable was the frequency with which pairs were seen in copulation and the length of time they remained *in coitu*. Frequently a dead fly of either sex was seen linked to one of the opposite by the powerful male claspers.

Only three of the ten apparently mature pupae obtained by us ever produced imagines (in about a month's (?) time, not longer). Three of the pupa were of *Glossina fusca*, none of them hatched. One female *G. fusca*, kept in captivity for over three weeks, deposited an apparently mature larva on March 28th, and another in the afternoon of April 1st. When found, very shortly after extrusion, the larva was white. An hour later the pupa had become a light brown. At the end of the second hour, it was much darker; after $4\frac{1}{2}$ hours the pupa was almost black, but it was noted that the under side seemed less dark than the upper side exposed to the light.

So long as the flies were fed once in twenty-four hours the frequency of feedings and the numbers of trypanosomes, often enormous, ingested with the blood seems to have had no effect on the length of their lives.

If they were left without an opportunity to feed for much more than 24 hours they died very quickly, about 91 per cent. in 37 hours. Neither sex seemed particularly resistent.

To feed the flies the cage was simply pressed against an infected person or animal, and so long as the victim kept fairly still the flies

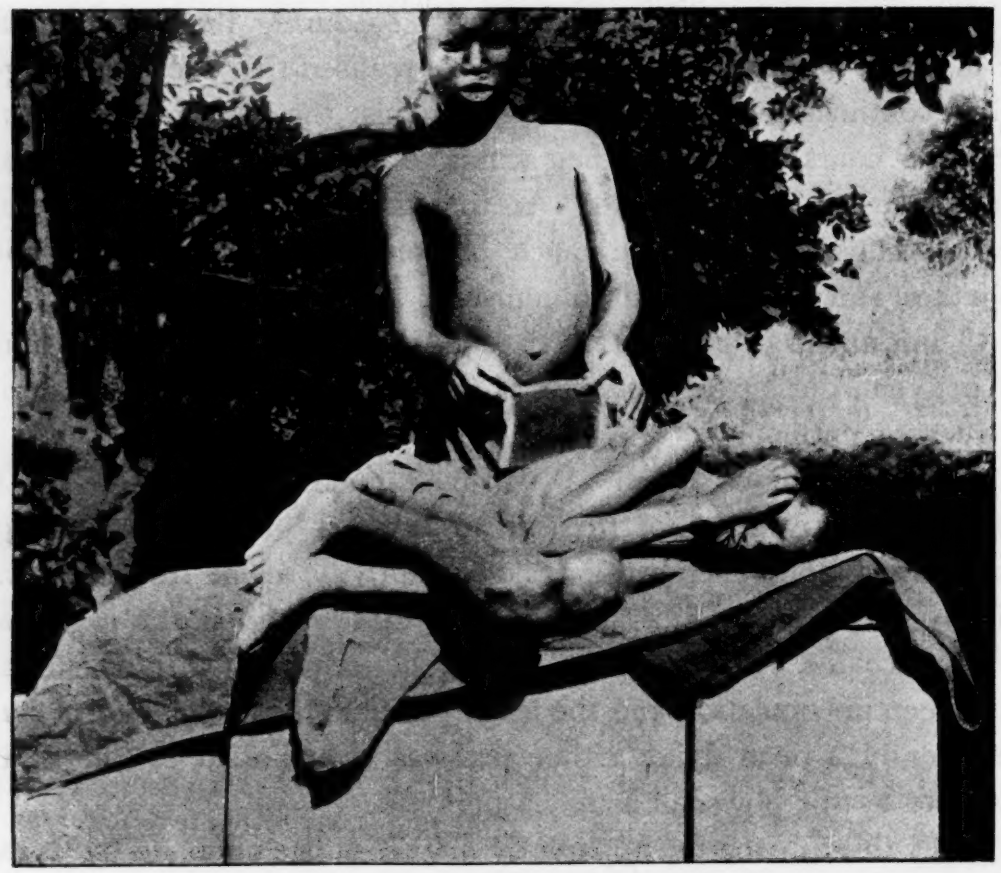

FIG. 15. METHOD OF FEEDING TSETSE FLIES.

fed without difficulty. They showed no preference for human blood, and practically the same percentage of flies fed on whatever animal (man, monkey, guinea-pig, &c.) was offered. On one occasion they were persuaded to suck blood from a frog.

It is calculated from observations on several thousand flies that on an average 80 per cent. of our flies fed when the opportunity offered. In special cases, when great care was used to keep animal and cage perfectly still and the feeding was persisted in for some hours, much larger percentages were obtained—frequently 100 per cent. Flies which had only partially filled themselves could often be persuaded to at once resume their meal on a second animal. It was practically

impossible to get flies which had been allowed to gorge themselves to again feed within from three to five hours' time, although they would do so readily eight hours after a first feed.

It has already been stated that *G. palpalis* may buzz loudly while flying. When at rest, often just after feeding, it sometimes produces a shrill, high-pitched note. A wingless fly was watched with a pocket-lens while sounding in this way. The tips of its halteres were seen to be depressed downwards and forwards, but the mechanism by which the note was produced was not ascertained.

Glossina palpalis, var. *wellmani*, Austen

Localities:—On the Congo River, between Nyangwe and Kasongo; on the Gambia River, near its mouth, at Oyster Creek.

Circumstances of capture:—So far as was observed the habits of these flies were quite similar to those of *Glossina palpalis*.

Glossina morsitans, Westwood

Localities:—Specimens have been received, through Monsieur Brohez, only from the Katanga district. The exact locality and the circumstances under which they were caught are not certain, but they were probably taken along the Luvua River near Pueto. Dr. Hosselet definitely reports that this fly is everywhere present in the zone of Uele, but we have seen no specimens.

Glossina fusca, Walker

Larva (dissected from body of parent but fully matured).—This consists of twelve strongly defined segments; surface finely tesselated, the individual tesserae being circular, flat, and shiny. Form, rather short ovate. Mouth-hooks relatively large, black, rather widely separated, but not porrected. Anal segment or "black hood" very coarsely rugose, the space between the converged points of the tumid lips one-third the diameter of one lip. Colour white, with a trace of lemon-yellow; hood or anal segment black.

Length 5·50 to 6 mm.; width 3 to 4 mm.

Pupa much more tumid and ovate than that of *G. palpalis*, especially so posteriorly. The tumid lips are also more depressed, and being continuous at their bases and only slightly divided posteriorly form a deep siphon-like tube or crateriform process, so

deep that it is impossible to see the stigmata which lie in the interior. Colour, dull steel-black, without any trace of the dull steel-blue seen in the puparium of *G. palpalis.*

Length 7·50 to 8 mm.; width 4 to 4·50 mm.

Localities:—Leopoldville (Dec.; reported, all the year round); Tshumbiri; Yumbie (Dr. Rodhain); Lukolela (Rev. Whitehead); Bolengi (Dr. Dye); Coquilhatville (Dr. Mordighlia); Nouvelle Anvers; Bwela (reported, Rev. Kenred Smith (*longipennis* ?)); Aruwimi River; Lulu River (reported, Commandant Lund (*longipennis* ?)); near Lalowa; near Utikakadja; Sendwe; Mfunkiva; Kasongo (Oct.-May).

Circumstances of capture:—This fly occurs in very much smaller numbers than *G. palpalis* and it is the rarest thing for more than one to be seen at a time. Most of our specimens were caught in the bush or from canoes paddled slowly along the edge of a wooded stream. None were seen to fly on board the steamer used by the expedition on their journey from Leopoldville to Stanley Falls, although a dead *Glossina fusca* was found in one of the cabins. *Glossina fusca* has frequently been observed in the Congo to be more or less nocturnal in its habits.*

A buffalo was shot. Part of the carcase was sent by canoe to camp, where it arrived about an hour after nightfall. By the light of a lamp a large *fusca* was caught trying to feed—there was no blood in its stomach—on the buffalo's neck. A night or two later a pair of *G. fusca* were caught, *in coitu,* about the lighted lamp in a tent. On two occasions specimens have been caught after nightfall in the illuminated tents of the expedition.

One or two observations on the bionomics of this fly have been included in the notes on captive *Glossina palpalis.*

Glossina pallidipes, Austen

A single specimen of this fly was obtained at Kasongo. No others were seen, although 1,053 tsetse flies, caught for transmission experiments, were carefully examined.

Glossina longipalpis, Wiedemann

Localities:—This fly has only been sent to us from the Katanga district. Two lots of specimens were received. One reached us through Major Malfeyt, the other was sent by a local official from the Upper Luapula.

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* Memoir XIII, Liverpool School of Tropical Medicine.

Field notes:—It is asserted locally that these flies are more persistent and feed more viciously than *Glossina palpalis.*

Glossina maculata, n. sp. (Newstead)

(Pl. iii, figs. 5, 6)

General appearance.—Very dark brown; posterior surface of head cinerous, spotted with black; thorax dark brown and faintly cinerous in places, with elongated transverse black spots; pleurae, coaxe and femora cinerous with conspicuous black spots; first and second segments of hind tarsi dark. (The remaining segments wanting.)

FEMALE.—*Head* with the frontal stripe rich ochreous brown; frontal margins and occellar spot bright yellowish-white to pale ochreous; ocelli black; posterior surface of head cinerous *with large well-defined irregular black spots. Antennae* dull red-brown in front, sides with a cinerous surface; arista dull reddish-brown. *Palpi* blackish above, paler beneath. Bulb of *proboscis* dark castaneous, shining. *Thorax* dark brown and cinerous with numerous irregular elongated black spots placed transversely; anterior angles pale brown. The scutellum spotted like the thorax, margin pale brown; pleurae cinerous and pale brown, with numerous, irregular, and more or less confluent, black spots. *Abdomen* very dark brown; the narrow basal segment cinerous, with numerous black spots; the broad second segment with the large median area, the anterior angle, and broad hind margin, cinerous, with black spots; the remaining segments, with the exception of the last, with a narrow well-defined median stripe, and hind margins narrowly cinerous; lateral margins of segments three to five with a cinerous triangular patch; the hind margins with an occasional, more or less obscure, black spot, with the exception of the sixth, which has a regular series of ten or eleven on the grey cinerous band; last segment darker than the rest with a lateral greyish spot in the centre of which is a small black one. *Legs:* All the coxae cinerous and pale reddish-brown, with numerous more or less confluent black spots; anterior and mid femora cinerous basally and apically bright red-brown, cinerous area with numerous confluent black spots; hind femora with the basal third and apex pale red-brown, the rest faintly cinerous with a few large, faint, dull brown blotches; anterior and hind tibiae pale brown, mid tibiae slightly darker with, in some lights, faint indications of dark spots; anterior

tarsi and first segment of the mid pale brown; first and second segment of hind tarsi dark brown. (The remaining segments of the mid and hind tarsi are unfortunately wanting.) *Wings* uniformly brown.

Length,* exclusive of proboscis, 9 mm.; length of wing 9 mm.

A single specimen of this fly was sent to us by the Rev. and Mrs. Billington. It was collected by them at Tshumbiri in 1905.

This interesting species may be readily recognised from all other members of the genus, by the curious spotted or mottled appearance of the thorax, pleurae, and femora. To the unaided eye it looks very like a dark specimen of *Glossina palpalis*, R.D.; but a pocket lens immediately reveals the peculiar markings.

FURTHER NOTES ON THE DISTRIBUTION OF TSETSE FLIES

Trustworthy persons frequently stated that tsetse flies of small size (not *fusca* or *longipennis*) existed in various localities. They were, however, unable to further identify the fly, and did not procure specimens. We have therefore compiled the following supplementary list of places in which tsetse flies occur. The names occurring in it have been considered in the preparation of the map showing the distribution of the *Glossinae*.

Matadi; Loeka; Redjaf, Lado Enclave (reported, Dr. Bignami); Makanga, Maniema (reported, April, 1905, Chef de Poste); Bene Kamba, on the Lomami River (recognised by natives); "All along the road from Kasongo to Baraka" (reported 1905, Bishop Roelens), confirmatory reports have been received from the following places along this route: Piani Lusangi, Kabambare, Kalembelembe, Yamba-yamba; Kibonga, Lake Tanganyika (reported, Chef de Poste); Lake Kivu (reported, Commandant Crone); Upper Luama River (reported, Bishop Roelens); "Places where tsetses do not exist in the Katanga district are so few as to be negligible"† (reported Feb. 4th, 1905, Monsieur Baillon, Chef de Secteur). Places in Katanga at which

* The abdomen is curved considerably, but this has not been allowed for in the measurement.

† This statement is in every way supported by numerous reports received by us, a few of them are cited, and by a recently published pamphlet entitled "La Mouche Tsetse et la Colonisation au Katanga, par le Lieutenant Brohez 1905, published by Vanderauwera et Cie, 59 rue de la Montagne, Brussels."

tsetses are definitely said to exist are: Ankoro; along the Lubili River; on Lake Tanganyika at Mpala and Vua;* Lusaka; Kiambi; Mpweto; Lukonzolwa; Kilwa; Lukafu; Kasenga; Kambove; Tenke; Shiniama; Kalonga and along the Lualaba, Lufira and Luapula Rivers; Upper Kasai and Luebo Rivers (reported, Mr. Verner); Angola (reported, Bastian, Interpreter at Lusambo); Popokabaka (reported, Dr. Hollebeke).

Map II has been prepared to show the distribution of *Glossinae* in the Congo Free State. For the sake of uniformity we have used the same signs as Mr. Austen to indicate the various species of *Glossinae*. As will be noted, our observations confirm his map in many instances and amplify it in others. In it has been incorporated the information contained in the article on tsetse flies by Austen, published in Volume VI of the Reports of the Sleeping Sickness Commission of the Royal Society and in a communication, on the same subject, made by Laveran to the Academie des Sciences.†

Remarks.—An important deduction to be made from the above notes on the *Glossinae* is that *Glossina palpalis*, at least, cannot be said to be absent from a given spot until several careful searches have been made at considerable intervals of time.

A careful study of the bionomics of tsetse flies is still urgently needed. Comparatively little is known at present concerning their habits; especially lacking is accurate information on the variation of their numbers in various localities ("fly belts") and on the causes governing their appearance or disappearance. On only one occasion did any hint of a natural enemy of these flies reach us.

The Rev. Mr. Grenfell had slightly wounded a bird (a darter?—native name, *ullinga*). It was taken living into the canoe in which he was travelling, and it was seen to eagerly catch the tsetse flies flying about the native paddlers.

GENUS STOMOXYS

Stomoxys calcitrans, Linn.

(Pl. iii, fig. 4; Pl. v, figs. 1-8)

Localities:—Lulango; Lusambo; in the Gambia at Bathurst and McCarthy Island.

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* Dr. Noble has recently identified the tsetse flies "plentiful at Vua" as *G. palpalis*.

† "Comptes rendus des séances de l'Académie des Sciences, t. cxli, p. 929, 4 décembre, 1905."

Circumstances of capture:—This fly was caught in the open and in the houses of Europeans. It feeds on all mammals, but seems to be especially fond of feeding at the tips of dogs' ears. Both on the Gambia and on the Congo dogs were often seen with their ears raw and bleeding from the attacks of this pest.

*It is, I believe, over 60 years since Bouché discovered the larvae of *Stomoxys calcitrans* in warm stable-manure. Since that time no additional information on the habits of this insect has apparently been given†; and the characteristics of the earlier stages and also the metamorphoses have remained practically unknown. It was resolved therefore to:—

1. Trace out the life-history and metamorphoses by rearing the insect from the egg; and
2. To find the natural habitat for the eggs, larvae and pupae.

The first was accomplished with comparatively little trouble; but the finding of the natural habitat for the earlier stages of this insect proved no light task, and involved a considerable amount of time and diligent searching. In the end, however, I succeeded in solving these problems; and it is hoped that these notes will not only prove of interest, but also of some practical value to those students who are engaged in the study of insects in connection with the transmission of disease by blood-sucking flies.

During the month of August an unremitting search was made for the larvae and pupae of this insect in the faeces of nearly all the domesticated animals, both in the farm-yards and the fields, but without success; manure heaps both old and recent were also searched, but none were discoverable. A number of females were

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* Newstead. Reprinted from the Journ. Econ. Biol., vol. i, No. 4, pp. 157-166, pl. xii, 1906.

† Howard, whose excellent paper on "A contribution to the study of the insect fauna of Human excrement" (Proc. Washington Acad. of Science, Vol. II, p. 578) I had overlooked, says:—"Our first experience with the breeding habits of this fly was in 1889, when studying the horn fly of cattle. August 20, 1889, four specimens of *Stomoxys calcitrans* were reared from horse manure collected at Washington, and on the 19th of the same month large numbers of adults were observed by Mr. Marlatt, attracted to freshly-dropped horse manure. January 20 and May 14, 1890, other specimens were reared from horse manure, the last lot of manure being collected on November 27, 1889, so that the insect hibernates in either the larval or pupal condition (probably the latter) in or just under old manure.

"This species has not been bred from human excrement, but has been observed in out-of-door privies at Snickers Gap, Virginia; Alexandria, Virginia; and at Charlestown, West Virginia."

then captured and placed in a large cage well supplied with light and air, and fresh faeces of the horse, sheep, and rabbit. A small percentage of the insects laid their eggs under these conditions; but the eggs were invariably removed to receptacles which were more convenient for the study of the metamorphosis. It was found that two important conditions were necessary for the development of the larvae, viz., an almost complete absence of light and *an abundance of moisture.* Such conditions as these could only obtain in a state of nature in large faeces in shady or damp situations, or in heaps of manure.

Towards the end of September the earlier stages of this insect were found under natural conditions, and the facts relating to them are given under the heading of additional field notes.

HABITAT.—Farm-yards and stables are evidently the favourite haunts of this fly; it occurs also in the fields, parks, and open woods, especially where cattle are grazing, but is much less numerous in such places. It is evidently also by no means uncommon in some of our large towns, and numbers were seen at rest on the shop-fronts in the main streets of both Liverpool and Chester. It is fond of resting on surfaces fully exposed to the sun, such as doors, gates, and rails, and to a less extent also on stone and brick walls. Painted surfaces are also attractive to it, and the greatest number seen congregated together were disporting themselves on the sunny side of a red-painted iron tank at the old Chateau de Goumont, Waterloo, Belgium. They are very active; but their flight is quite inaudible at a short distance, the noise produced being very feeble. When disturbed they frequently return to the same spot, but more especially so in favourite resting-places. At night they retire to some sheltered spot, and numbers may be found at rest on the beams and rafters in open sheds in farm-yards, where they remain, almost inert, till the morning sun tempts them out again. They will also occasionally enter stables in the day time, and they were seen to enter such places through a narrow opening or a crack in the door.

They frequently clean their wings when in captivity, and this is accomplished with great precision, the hind legs being used for this purpose. The under surface of the wings are first combed, then the upper, the legs are then rubbed together, and the process is again repeated in exactly the same order.

POSITION WHEN AT REST.—The front part of the body is often slightly raised, but not invariably so; and the wings, which invariably touch at their bases, are widely divergent and carried in a horizontal position, lying practically in the same plane as the abdomen.

RATIO OF SEXES.—During the heat of the day the males preponderated;* but towards evening the sexes occurred in about equal numbers; the captured females were, however, nearly all freshly emerged ones, and a large proportion of the eggs which they laid in captivity proved infertile.

FOOD OF THE ADULT.—During a period of 14 days a careful watch was kept on both cattle and horses in various farm-yards where the flies were common, but no flies were seen either to alight upon the animals or to suck blood from them; at the same time several examples of both males and females were captured which were fully engorged with blood. Moreover, a freshly emerged male readily sucked blood from the writer's own hand. There is, however, no lack of authentic evidence as to the blood-sucking habits of this fly which need not be repeated in this communication.

Two specimens were seen to settle on fresh cow dung, and apparently feed upon the moisture on it, passing the extended proboscis rapidly over the surface; such habits were apparently exceptional or rarely seen in a state of nature; but in captivity they readily fed on the fresh faeces of the horse and sheep, more especially so on the latter. A female was also seen to drive its proboscis into the thorax of a dead companion and apparently suck up the juices of its body. Three specimens fed upon some sugar and water, and some also sucked up the moisture from a decayed and fetid potato.

MOVEMENTS OF THE PROBOSCIS.—The base of the proboscis is frequently depressed so that the palpi become fully exposed, but the tip of the labium remains practically in the same position, or is very slightly elevated. The elbowed joint in front of the palpi is very flexible, and can be instantly inflated so that the entire proboscis can be completely straightened, and either extended horizontally or depressed vertically. The labella can also be:—

1. Straightened, taking the same plane as the labium proper. This is the normal resting position.

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* The ratio was about 3 males to 1 female.

2. Curved upwards and outwards, with a quick alternate movement to either the right or left, or repeatedly and rapidly curved to one side only. As the labella curve upwards the *anterior* portion of the labium also gives a distinct lateral twist, so that the dorsal groove is presented laterally.
3. The teeth of the labella can be curved outwards and ventralwards, giving them a bilobed appearance; the teeth also apparently move rapidly backwards and forwards, and a clear fluid was seen to pass down the tube when the insect was slightly pinched between the fingers.

In sucking blood from the writer's hand the insect sat high upon its legs, but the anterior pair were much elbowed, and all the joints of the tarsi generally rested upon the skin of the host. The whole of the proboscis was straightened and held vertically, and the anterior third was driven into the flesh.* During the process, which lasted altogether for a period of 15 minutes, the proboscis was constantly, but somewhat slowly, moved up and down, and also with an occasional semi-rotary movement, reminding one somewhat of the action of a quarryman's hand drill. This action was continued until the fly had pumped its body full of blood. The initial pain was trifling compared with that of a mosquito; but there were two subsequent pricks which were quite as irritating as the first. A small drop of blood was left over the puncture, and when this was washed away a small roseala was revealed; but there was no subsequent irritation or soreness of any kind. A clear fluid was passed from the anus four times during the process, and on several occasions subsequently, and judging from the size of the abdomen the food was rapidly assimilated. This fly died twelve hours after feeding.

DURATION OF LIFE.—In captivity they lived for several days; but they were supplied with abundance of fresh air and some moist faeces. The females died either immediately or shortly after laying their eggs.

EGG-LAYING.—When the female is about to lay its eggs the ovipositor becomes fully extended, and nearly equals the length of the abdomen proper. The eggs are passed rapidly down the ovipositor at intervals of a few seconds,† and were usually laid in an irregular

* In thick-skinned animals the proboscis would in all probability be driven in still further.

† 5-30 seconds.

heap. In some instances the female was seen to separate the eggs by carefully passing her proboscis between them, and then drag them away or scatter them with her legs. In cases where the eggs were laid during *extremis* the female generally died on the spot, and made no attempt to scatter them. Counts were made of seven batches, the maximum being 71, the minimum 48; the actual counts were 48, 48, 54, 57, 59, 62, 71. The incubation period, at an average temperature of 72° F. in the day and 65° F. at night, was two to three days.

TIME OF APPEARANCE.—They are especially abundant during August and September; but gradually diminish in numbers during the early part of October;* and few examples are seen after a spell of cold wet weather.

THE EGG.—Coriaceous; white at first, but changing to creamy white. Those which were laid on faeces, fully exposed to the sun, had the exposed portions tinged with pinkish-brown, but this colour eventually disappeared. Form very elongate, shaped somewhat like a banana, being curved on one side and almost straight on the other; the straight side with a broad deep groove which widens at the anterior end giving it a spatuloid form. Surface with faint polygonal reticulations. The larva effects its escape by splitting the broad end of the groove, leaving it slightly raised (see Pl. v, fig. 4), and apparently intact on the opposite side.

Length, 1 mm.

THE LARVA.—Colour, creamy-white to pale ochreous, translucent, shining and almost glass-like; sub-cutaneous mouth parts black; the convoluted alimentary tract when filled with food gives the posterior half a blackish or greenish-black colour; tracheal tubes forming two-submedian white lines and delicate lateral branches. Posterior stigmata black; thoracic stigmata ochreous. Form long, tapering to a point in front, widely rounded posteriorly. Segmentation not very pronounced. Epidermis without hairs. Head with two large divergent mammiform processes, at the extremity of which are the minute retractile antennae, apparently of four sub-equal segments. The mouth armature consists of five distinct parts: a strongly falcate hook in front, which articulates with a broad, thick and somewhat rectangular hypostomal sclerite; immediately below the great hook is

* A single specimen was seen in Liverpool on a bright sunny day during the first week in November.

a small dentate sclerite; the hypostomal sclerite articulates with two large bifurcated cephalo-pharyngeal sclerites, and in front of the upper arms of these pates is a small perforated sclerite. In a freshly prepared specimen both the retractor and extensor muscles to these sclerites can be distinctly traced. Ventral surface of the last seven segments furnished with raised bands of tactile tubercles. Posterior stigmata two in number, circular; thoracic stigmata placed sub-laterally on the third segment, each consisting of apparently five circular orifices, these are connected posteriorly with a large bilateral air sac which extends along the fourth segment.

Length of adult, 11 mm.

Young larvae are much more transparent and glass-like, and the large anterior mouth-hook is not developed, a blunter process taking its place.

HABITS OF THE LARVAE.—They move rapidly along a smooth surface, pulling themselves along chiefly by means of the large mouth-hook; and proceed practically in a straight line, moving the head rapidly but irregularly from side to side or up and down. There is, however, no regular alternate movement of the head during progression as in some muscid larvae. Their progress through the burrows in their food is much more rapid than on a smooth surface, and when disturbed they disappear with extraordinary rapidity. The larval stage lasted, under favourable conditions, from 14 to 21 days; *but the absence of excessive moisture* and the admission of a little light materially retarded their development, which then extended over a period of from 31 to 78 days.* The larvae exposed to such conditions produced much smaller pupae and correspondingly small imagines.

METHOD OF PUPATION.—This is completed in about two hours. At first the larva rapidly shortens itself, chiefly by contracting the anterior segments, and becomes barrel-shaped. At this period it is of a creamy-white colour, and the mouth parts of the larva are still visible through the soft integument. The colour rapidly changes to bright ochreous, and in the space of two hours or even less, the integument hardens and the puparium assumes its normal colour. In cases where soil was placed below the faeces the larvae generally burrowed into the former to a depth of about half an inch, but a few also pupated

* A few specimens still remain in the breeding cage, and may possibly pass the winter in this stage.

in the dryer portions of the dung. Where no soil was provided the larvae generally pupated at the bottom of the breeding cage.

THE PUPARIUM OR PUPA.—Colour bright terra-cotta red, changing to dark chestnut-brown a few days before the emergence of the fly. Form barrel-shaped, slightly narrowed in front, broadly rounded behind. Eleven segments only are visible, the anterior one bearing the minute bilateral thoracic stigmata of the larva; posterior segment with two large disc-like stigmata; all the segments with fine transverse striae, the striae, under the microscope, producing a slight irridescence; dorsally the articulations have a double series of minute papillae, one series being more minute than the other; the posterior segment has also a median longitudinal series which terminates between the stigmata; ventrally the papillae are replaced by a regular series of fine ridges, forming a distinct and relatively broad band; the last segment also bears a somewhat lunular or angular-shaped patch of more or less rounded papillae. This stage lasted from 9 to 13 days.

Length, 5 to 5·50 mm.

The larvae fed on comparatively dry faeces produced much smaller pupae—3·50 to 4 mm.

DEVELOPMENT OF THE NYMPH.—A few days before the emergence of the insect the cuticle of the puparium darkens and eventually splits anteriorly along the lateral and median lines and also transversely along the fourth segment; the section falls away, and the fly escapes. Prior to this the nymph undergoes its final ecdysis, pushing its effete skin off backwards into the posterior end of the puparium. On its emergence it appears as a small dark-grey fly, with thick rudimentary wings of a dull leaden colour and a deep notch in the mid costa, below which are strong convoluted folds. The head is much larger and wider than the thorax, and the abdomen is attenuated. Its subsequent development may be conveniently divided into the following stages:—

1. An extremely active period, which lasts for approximately half an hour. During this period the insect devotes nearly the whole of its attention to the escape from its environment. If placed in a glass tube with a barrier of loose cotton wool in it, the fly immediately endeavours to effect a passage through it, and this it accomplishes with marvellous rapidity,

making headway by constantly inflating the frontal sac, at the same time pushing itself forward with the legs. When liberated, a great deal of time is devoted to combing out the hairs on the arista of the antennae, this being accomplished in the following way: the head is turned either to the right or left, as desired, and the frontal sac is then inflated on that side farthest from the thorax; this process lifts the antennae into a prominent position, and the long hairs of the arista are then rapidly and carefully combed out with the under surface of the anterior tibiae. The frontal sac also receives a share of attention, and so also does the abdomen, and occasionally the rudimentary wings. This stage is remarkable, in that nature so provides that, under normal conditions, the insect may successfully escape from its larval habitat before the wings develop, and so impede its progress or render its escape impossible.

2. In this stage the frontal sac is usually contracted, and the head presents a more normal condition; the fly also becomes quiescent, and remains as a rule in a fixed attitude, with the legs well displayed, and the head extended forwards, so that the narrow neck is stretched to its fullest extent. Air is then pumped into the body by repeated and alternate contractions and extensions of the abdomen. The body increases in size, and the integument becomes *extremely pallid in colour*. At this stage the wings are apparently filled with air, which passes rapidly along the costal region, then across to the hind margin, and finally the tip unfolds, sometimes aided by the use of the hind legs. The first portion of this stage sometimes occupies over twenty minutes; but the wings develop as a rule in about three minutes.

3. The fly still remains more or less quiescent, but gives some attention to cleaning itself, and when the integument and the wings are sufficiently hardened the proboscis is raised from the ventral to its normal horizontal position; when this is accomplished the insect takes flight.

Defaecation takes place shortly after the imago is perfected; the faeces being milk-like both in substance and colour.

Summary of Life Cycle.

Larvae fed on moist sheeps' dung.

Eggs procured from captive females.

Average day temperature	72° F.
Average night temperature	65° F.
Month	August.
Ova—Incubation period	2—3 days.
Larval stage	14—21 „
Pupal stage	9—13 „
Complete cycle	25—37 „

Summary of Life Cycle.

Food allowed to partly dry and some light admitted.

Temperatures as above, during the month of August.

Ova—Incubation period	2—3 days.
Larval stage	31—78 „
Pupal stage approximately as above,	
Complete cycle	42—78 „

Some larvae of this brood may hibernate through the winter.

Additional Field Notes.

While this paper was going through the press I continued my search for the larvae at various places within a few miles radius of Chester, and on 21st September my efforts were at last rewarded by finding the insect in all stages of its metamorphosis. The habitat was on the outside of a cucumber bed, at Rossett, Flintshire. Here both males and females were disporting themselves on the cucumber frame and also on some matting used for covering the glass. My attention was first given to an examination of the stable manure forming the hot-bed, but this was quite unproductive, as I ventured to think that it would be, owing to the rather dry nature of the outer walls. But lying alongside the cucumber bed was a heap of grass-mowings which had accumulated during the season. The uppermost layer had only recently been deposited, and this was quite hot (90° to 98° F.), below this the grass was quite rotten and sodden with moisture, but registered a temperature of 70° F. It was in this layer that I found the

first lot of larvae. They were chiefly full-fed, and some of them pupated during the next two or three days. Continuing my search further I also found numbers of larvae and pupae, in the still older and quite cold deposits, some of them were only a few inches below the surface, others were deeper down; they sometimes occurred singly, in other cases several were found together, some were mature, others only partly developed. On disturbing the newer deposits they naturally gave off the strong smelling fumes characteristic of heated grass, and this produced a result which I had neither hoped for nor anticipated. A female Stomoxys was seen to alight on the hot and freshly disturbed grass and to quickly disappear among the interstices, there she remained for a minute or so and then flew away. The grass was carefully examined, and amongst it, at a depth of nearly three inches, were found a number of her eggs. A regular succession of females then followed, and very soon three of them were engaged in laying their eggs in a small area which could have been covered with a crown piece; the first-comer being not in the least disturbed by a companion running completely over her body. In all cases the abdomen was depressed, and pushed into the material as far as possible, and in two instances the wings were partly extended, in order, apparently, to secure a firmer support. One female remained in the same spot for five minutes, and then changed her position to another a few inches away. A second female was occupied for twelve minutes in laying her eggs, but she did not change her position during the time. All three females flew away immediately afterwards, and did not seem in any way weakened by the process. For how long they survive in a state of nature it is impossible to say, but some females that were caught immediately after egg-laying died on the fourth or fifth succeeding days. Some females which were caught in glass tubes as they alighted on the grass laid their eggs immediately afterwards, and these also survived until the fourth and fifth days.

Reference has already been made to the almost noiseless flight of these flies when disporting themselves over and about their favourite haunts during the heat of the day. But I found that when the females were negotiating the habitat previous to laying their eggs the noise was distinctly audible, and resembled the characteristic hum produced by other muscids.

The day on which the foregoing observations were made was a delightfully bright and sunny one, and the hour from 3 to 3·45 in the afternoon; later, when the sun had lost its power, the flies disappeared, in their usual way, to find some sheltered spot in which to pass the night.

The eggs which were procured on this occasion were kept at a temperature varying between 64° and 67° F.; under these conditions the larvae did not begin to hatch until the *eighth day*, thus the incubation period was greatly prolonged; had they been left in the warm grass, where the temperature near the surface was 70° F., they would in all probability have hatched, as they did in the summer months, on the second or third day.

Whether the larvae of these autumn broods will pupate before the winter is at present impossible to say, but judging from the high temperature of the habitat, which will certainly be maintained for a fortnight at least, it is reasonable to assume that they will do so, and we shall probably find that the winter is passed chiefly in the pupal stage.* Any material disturbance of the habitat in question would result in complete loss of the artificial heat and a sudden check to the development of the larvae. In such a case the larvae would probably hibernate through the winter and pupate in the following spring or early summer. Fortunately this is not likely to obtain in this instance, as the owner has very kindly given me undisturbed possession of the whole of the material, so that it will, it is hoped, be possible to continue the observations through the winter and spring, though little of economic importance can now be added to the habits of the insect in this country.

Stomoxys sitiens, Rond.

Localities:—Nouvelle Anvers; Lulongo; Nyangwe; Kasongo.

Circumstances of capture:—Specimens were caught about cattle and in a European house. It feeds vigorously.

Stomoxys sitiens ?

A large series of specimens were caught on cattle at Zambie. They were preserved in alcohol and cannot therefore be definitely fixed.

* On Jan. 13th, both larvae and pupae were found in this habitat; the former were quite dormant, but became active in a warm temperature. Both stages occurred in the decayed grass about 6 inches below the surface.

Stomoxys omega, n. sp. (Newstead)

(Pl. iii, figs. 2, 3)

Wings dusky, strongly irridescent in a bright light. Thorax blackish, shining, anterior half in front of transverse suture pale greyish-blue, with a distinct ∩-shaped black design in the male; in the female the submedian black lines blend with the black colour in front of the suture so that the up-curved terminals of the ∩-shaped markings become indistinct. Abdomen, smoky-brown.

MALE.—*Head:* Eyes almost meeting, the narrow space between them, above, velvety black; frontal margins and clypeus silvery-white. Basal segment of antenna blackish; second segment brown; apical segment silvery-grey; arista brown; posterior surface of head velvety-black; lower angles silvery-white with black hair. *Proboscis* black, shining; labella with many, very long, fine outstanding hairs. *Thorax* in front of the median transverse suture grey-blue, with a large ∩-shaped black design, consisting of two distinct broad submedian longitudinal stripes which curve upwards before reaching the suture and form two conspicuous rounded dilations; thorax *below the transverse suture* black, shining, with a rather broad band of dusky grey-blue in front of the scutellum, which is continuous to the base of the wings; scutellum smoky-brown, shining; with one central and two lateral black bristles; the thorax is also clothed with fine blackish hairs, and there are three bilateral black bristles at the sides in front of the wings; pleurae in front delicate grey-blue, a small area at base of wing pale brown. *Abdomen* hairy; smoky-brown, the segments gradually darkening towards the apical margins, especially so at the sides; in perfect specimens there is a broad basal band on the second, third and fourth segments of faintly greenish-grey dust, each band is interrupted in the middle; the last segment almost entirely clothed with a paler grey dust; venter pale dusky-brown. *Legs* relatively long, smoky-brown, blackish in some lights; knees pale brown.

Length, exclusive of proboscis, 6 mm.; length of wing 7 mm.

FEMALE.—*Head* with the space between the eyes relatively narrow; vertex, blackish, shining; margins and clypeus pale bluish-grey, bright but scarcely silvery; posterior surface of the head similar to that in the male, but the sides below have a broader margin of blue-grey. Apical segment of *antenna* dusky-grey. *Thorax* in front

of the median transverse suture grey-blue, with two short, well-defined submedian black lines in front, these gradually merge into large and somewhat ill-defined black areas, leaving the blue-grey ground visible only at the sides and between the black longitudinal bands; thorax behind the suture as in the ♂; scutellum black, paler in the centre, shining; pleurae and legs as in the ♂. *Abdomen* similar to that in the male but *without the grey, dust-like margins.*

Length, exclusive of proboscis, 6 mm.; length of wing 6·50 mm.

Easily distinguished by the beautiful pale blue of the anterior half of the thorax, with, in the ♂, the distinct black ∩-shaped pattern.

The relatively narrow space between the eyes in both sexes is also noteworthy, these characters being much more pronounced than in the species of the *calcitrans* type.

Localities:—Ukungwa; Sendwe.

Circumstances of capture:—This fly was seen only near water. Some were caught in canoes, others on a buffalo shot in a marsh, on which they were feeding. When the buffalo was first seen it was lying half-covered in water, no doubt to avoid the *Stomoxys*, which were present in almost incredible numbers.

CUTANEOUS MYIASIS

? *Ochromyia anthropophaga* (E. Blanch.), in man.

We are greatly indebted to Dr. Grenade of Leopoldville for three specimens of a larva or "bot" closely resembling that of an oestrid fly, taken from a coloured patient in hospital at Leopoldville. Two of them occurred in the scalp, the other in the neck.

These larvae agree so well with the description given of *Ochromyia anthropophaga*, E. Blanch, that they possibly belong to this species or a closely related one.

Larva of a Muscid Fly in a Rat

The following description of a larva or maggot taken from the tail of a tame white rat at Kasongo, February 16th, 1905, may eventually lead to the identification of the insect; so far we have been unable to fix it.

Description.—Length 11 mm. Cylindrical, but slightly flattened; rather suddenly tapering in front, rounded behind but *not truncate.*

Segmentation very pronounced and regular above but convoluted ventrally; all the segments, with the exception of the antepenultimate which carries the anterior stigmata, almost covered with very short and rather blunt spines, the majority of which have dark brown or piceous tips; these spines are arranged in short straight transverse lines, each group consisting usually of from three to five spines, in some cases there are but two and in others more than five. The great mouth hooks are black; and there is a lateral palmate group of external teeth as in the larva of *Auchmeromyia luteola* (q.v.). Posterior stigmata on the last segment, subdorsally placed, and very close together.

Further details cannot be given, as it has been thought well to preserve the specimen intact.

Larvae of a Muscid Fly in a Mule

The mule illustrated in fig. 16 was brought to us at Kasongo. In the centre of a large and very conspicuous oedematous swelling on its abdomen was a deep-seated ulcer, some three inches in diameter. On inspection, the whole ulcer, below the level of the epidermis, was found to be so closely set with the larvae, described below, that it was impossible to see any part of its base.

The mouth parts of the larva were invariably directed inwards and the bodies of the parasites were so deeply buried in the tissues of the host that their posterior extremities were alone visible. It was found that there were two layers, one above the other, of larvae, packed side by side closely together. It seems probable that they were able to burrow in the tissues of their host, since a few larvae were found in the sloughing tissues at a depth of some five centimetres from the apparent surface of the ulcer. None of the larvae penetrated into the abdominal muscles. About 160 to 180 larvae were taken from this lesion, which healed quickly after a thorough curetting and dressing with iodoform. A description of the larva is herewith appended:—

Length 11 mm.; greatest width 2·25 mm.

Colour, in formol, dull pink, with the anterior segments paler; some examples were almost white. Form spindle-shaped, tapering from the mid region almost to a point in front, and slightly so posteriorly. Great mouth hooks prominent, unidentate, and black. Segmentation very pronounced, each with a strongly marked ridge forming

a complete ring round the body; all the ridges furnished with short brownish-coloured spines, which to the naked eye appear as distinct equidistant rings; anal segment somewhat truncate, but deeply wrinkled, and furnished dorsally with four very short papillae and ventrally with two much longer ones. Anal stigmata, brown or dark castaneous, almost touching; irregularly ovate, with three transverse slits.

Attempts to raise the fly from these larvae were unsuccessful.

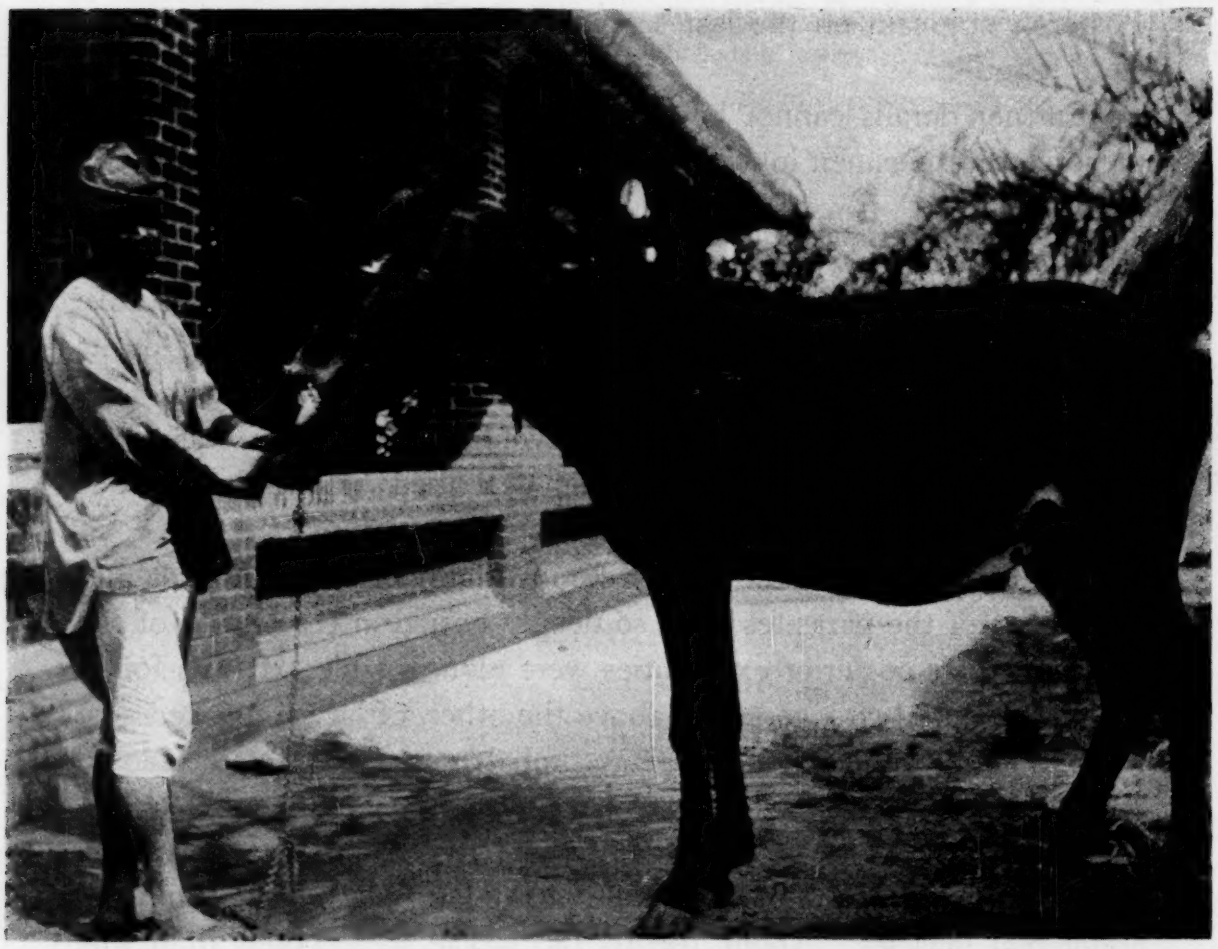

FIG. 16.—*Cutaneous myiasis.* Mule showing oedematous swelling on abdomen, containing larvae of a Muscid Fly.

FAMILY HIPPOBOSCIDÆ

Hippobocsa equina, Linn.

(Figs. 17, 18)

A few examples of this species were found on cattle, shipped at Las Palmas, Canary Islands, while on board ship on their way to the

Congo Free State (September 15th, 1903). This is an important record, and furnishes a further proof of the ready means by which these parasites may be introduced into a new and uninfected region.

Flies of this genus were also caught on camels and cattle at St. Louis, Senegal, May, 1903; their freshly deposited larvae were marked with very delicate tracings. Unfortunately the specimens and drawings were lost while in the hands of the Authorities of the British Museum and cannot now be traced.

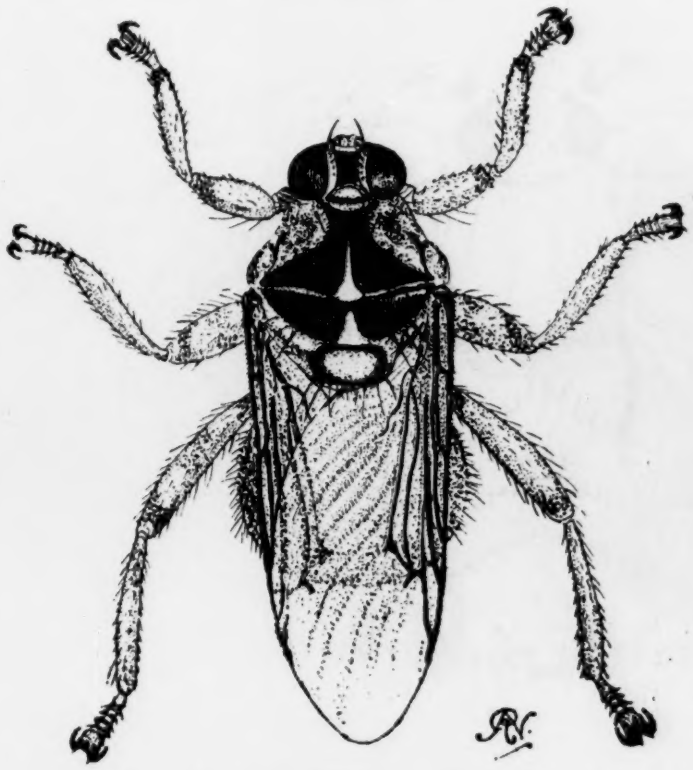

FIG. 17.—*Hippobosca equina*, ♀ . × 6.

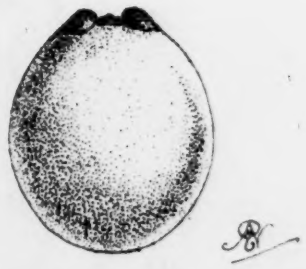

FIG. 18.—*Hippobosca equina* Puparium about twelve hours after extrusion. At this stage the anal tubercles are black; the rest of the integument terra-cotta red. × 6.

*Lipoptena** *paradoxa*, n. sp. (Newstead).

(Figs. 19, 20)

FEMALE.—Specimens preserved in Canada balsam and alcohol are bright red-brown inclining to orange-brown at the sides of the abdomen; claws black; base of abdomen with a bilateral patch of darker chitin, the median area of the remaining segments also with darker markings, but these are both irregular and inconstant in the preserved examples. *Head* as wide as the anterior part of the

* *Lipoptera* of Siebold and Loew.

thorax; ocelli absent. Mouth parts rudimentary. Outer margin of eyes with a double series of spinose hairs. *Thorax* narrower in front than behind, with a submedian series of about nine long spinose hairs forming a curved line, and a short submarginal series of usually four similar ones terminating opposite the insertion of the mid legs; posterior margins with four long spinose hairs on either side of the scutellum; the last-named organ is also furnished with four similar hairs. *Abdomen* short ovate, almost sub-circular, with numerous spinose hairs arranged as shown

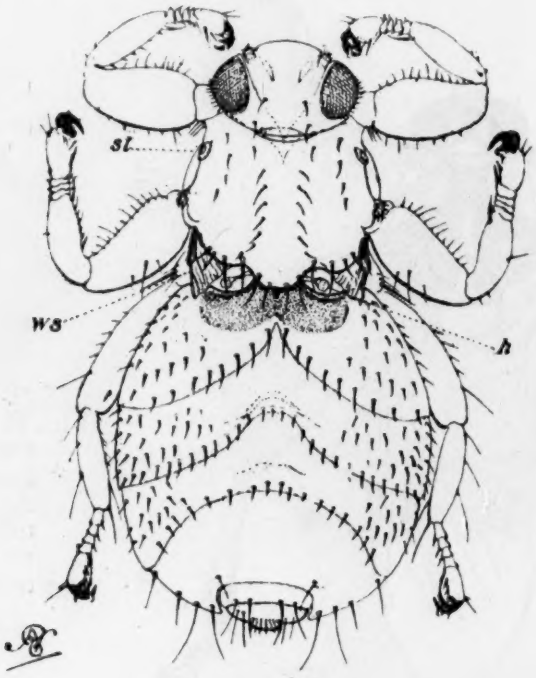

FIG. 19.—*Lipoptena paradoxa*, ♀ × 15. *st.* stigmen; *ws.* wing stumps; *h.* haltere.

in the figure. Venter with numerous short spinose hairs; median convex area with numerous minute equidistant tubercles bearing slender spinose hairs, the spaces between the tubercles finely but strongly rugose. *Legs* short, stout, sparsely clothed with hairs of varying lengths and varying degrees of thickness; the posterior pair not extending beyond the tip of the abdomen; tibial spine to anterior and mid legs stout; tibial spine to posterior legs long, slender; pulvillus broadly dilated from the middle outwards, finely spinose; feather-bristle strongly spinose; the upper surface with only one series of spines, the inner with two or three; ungues very faintly and irregularly toothed on the inner margin.

Length 4 mm.; width of abdomen 2 mm.

Habitat: Taken from an antelope at Kasongo, January 28th, 1905.

All four specimens are females. The same host also harboured a number of ticks. (q.v.)

The absence of ocelli in the female is rather remarkable. There is also an almost entire absence of *external mouth* parts, including the labial sheath; the only indication of these organs being a minute truncated cone, the exact nature of which could not be determined in the limited supply of material.

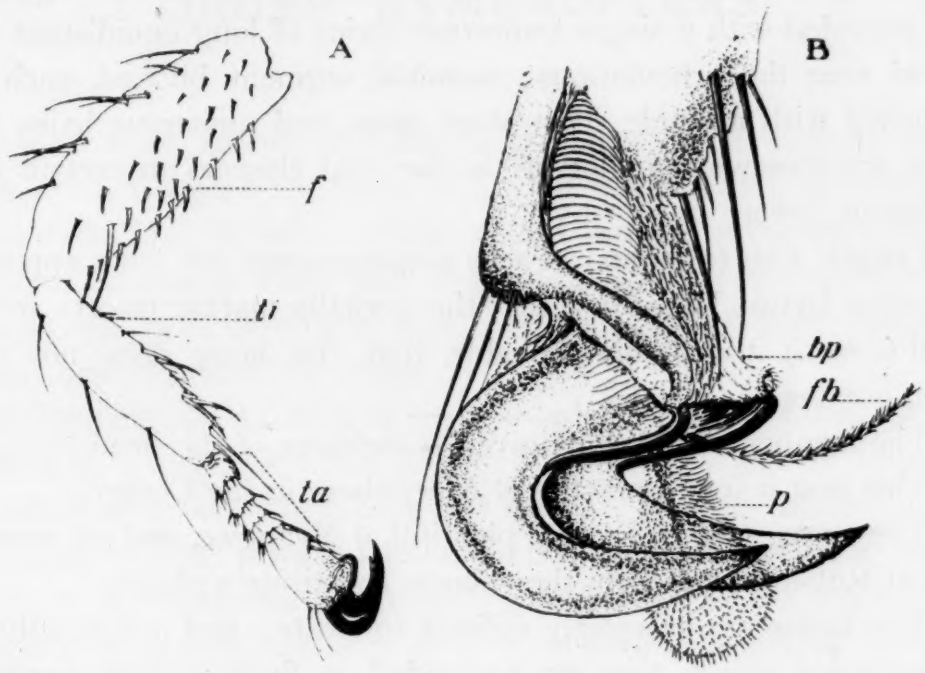

FIG. 20.—*Lipoptena paradoxa*, ♀. *A.* × 35; *f.* femur; *ti.* tibia; *ta.* tarsus. *B.* claws × 140; *bp.* basal process; *fb.* feather bristle; *p.* pulvillus.

FAMILY PULICIDÆ

Dermatophilus (*Sarcopsylla*) *penetrans*, Linn.

(Pl. vi, figs. 1, 2)

Larva long, cylindrical, of fourteen almost equal segments. Head slightly longer than the second segment, narrowest in front, but rather widely rounded. Antennae short, apparently of three segments, the basal and apical segments very short; apex with a central long slender spine and two to three minute ones. Surrounding the base of the antenna ventrally is a semicircular group of blunt spines, the two

nearest the base of the antenna much the largest. Mandibles large, slightly curved, unidentate. Cuticle below the buccal cavity with a curved row of short, stout, and backwardly curved spines; on either side of this series of spines are two divergent subcutaneous sclerites, the ventral one extending almost to the articulation of the head with the thorax; the upper sclerite about half the length of the ventral one; both are narrow and rod-like; the base of the ventral sclerite is also much dilated, and at the point where it meets the upper one it is unequally bifurcated and spine-like. Cuticle of all the segments presenting a strongly marked scale-like appearance; each segment is also provided with a single transverse series of long equidistant hairs, placed near the articulations; terminal segment bilobed, each lobe furnished with a single short stout spine and numerous hairs, these lobes are somewhat analogous to the anal claspers in certain Lepidopterous larvae.

Length 1·50 to 2 mm. These measurements are from apparently immature larvae, but seeing that the sexually mature insects are very small (1 mm.), it is highly probable that the larva does not attain much greater dimensions.

The number of segments given is inclusive of the head.

This pest is found practically everywhere in the Congo.

They were seen to be very plentiful at Nyangwe, and we were told that at Rutshuru and Beni they almost constitute a plague.

The larvae are extremely difficult to locate; and it was only after a prolonged search that we succeeded in finding three specimens. They occurred among the dust from the floor of a native hut which was literally swarming with chiggoes.

FAMILY PEDICULIDÆ

Pediculus capitis, De Geer.

This louse was only noted on cases of human trypanosomiasis at Leopoldville and Kasongo. Their distribution is most probably much wider.

Pediculus vestimenti, Leach.

These vermin were only noticed at Boma and Leopoldville; their distribution is very probably much wider.

ORDER HEMIPTERA

FAMILY CIMICIDÆ

Cimex lectularius (Common Bed-bug)

Localities:—Banana (Dr. Etienne); Tshumbiri (Rev. Billington); Nouvelle Anvers (Dr. Müller); Tshofa; Kabinda; Lusambo.

Circumstances of capture:—Specimens were taken from the crevices in the cane beds and grass-cloth pillows of natives.

ORDER HYMENOPTERA

Melipona, sp.

One or more species referable to this genus were seen in several places in the Congo Free State. They were particularly numerous at Leopoldville and Dibwe. They caused intense annoyance by the persistent manner in which they swarmed about one and crawled into one's mouth, eyes, nose and ears. When crushed they emitted a peculiar and characteristic odour.

At Leopoldville a colony of these stingless bees had taken up their quarters in a large lock and rendered it quite useless by the great accumulation of wax which they had formed. In this instance it was interesting to note a waxen tubular opening, about 4 c.m. in length and about the thickness of a pencil, projecting from the keyhole. A species of *Melipona* has been noticed to have very similar habits in the Soudan.*

INSECTS OF NON-ECONOMIC IMPORTANCE

In addition to the insects dealt with in the foregoing chapters of this Report, a large number of insects, representative of various orders, were also collected; but as they are of no economic importance it has been thought desirable to deal with these elsewhere. We would add, however, that among the more remarkable species is a new *Dejeania* which was discovered among the *Glossinae* in the fly cages at Kasongo. It had evidently been caught by one of the boys in mistake for an engorged tsetse, which it very closely resembles. We also obtained several specimens of a rather remarkable species of

* 2nd Report Wellcome Research Laboratory, Department of Education, Soudan Government, 1906, page 89.

Notocanthis of a uniformly blackish colour, with numerous white spots on the wings. These flies were only observed in one locality in the bush about a native village situated on high, dry, sandy soil, near Lisala (July, 1904). We possess no particulars concerning its habits. Whilst at Boma (Oct. 27, 1904) we also found a number of larvae or "rat-tailed maggots" apparently belonging to the genus *Eristalis*.

ORDER ACARINA

FAMILY HYDRACHNIDÆ

Ectoparasites of Mosquitoes

The larvae of four distinct species of *Acari* belonging to this family were observed on several species of mosquito. The site preferred by these ectoparasites was invariably the dorsal area of the abdomen, and generally, on the first few segments. Most of them, though not all, were fixed to the articulations of the segments, to which they seem firmly attached. The mosquitoes most subject to the attacks of these acarids were the following :—

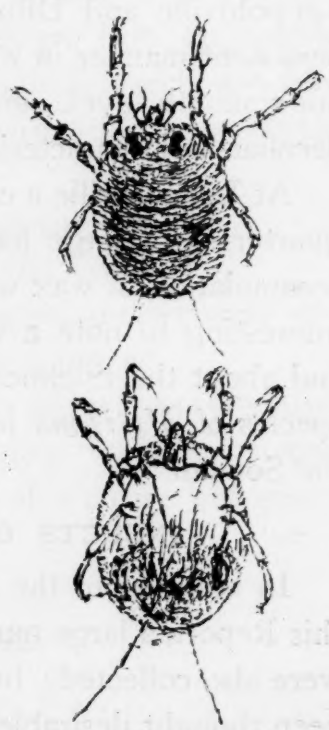

FIG 21.—*Ectoparasites of Mosquitoes.* × 20, about. From a sketch by the late Dr. J. E. Dutton.

Myzorhynchus paludis.—About 30 per cent. of these mosquitoes had the parasites attached to them. In one case as many as five were found clustered together on the articulation of a single segment. The species met with on this host (when dry) is of a bright ochreous colour with a dull orange scutum and rather large black eye-spots. The localities were Kumba, Kasonga and Lusambo.

Mansonia africana.—A large percentage of these insects also carried parasites, of which there were three well-marked species: one of a uniformly orange-red colour and another of a creamy-white or pale ochreous. In life some of these acarids were pink or yellow. Localities: Leopoldville, Tshumbiri, Kasongo and Lusambo.

FAMILY SARCOPTIDÆ

A case of Symbiotic mange occurred on a rabbit which was imported from Europe for experimental purposes. The condition was severe and the external ear was entirely filled with the parasites and the very profuse epithelial desquamation they had excited. On macerating the dead specimens in potash, one finds that they are a species of *Symbiotes* (now referred to the genus *Chorioptes*) and agree best with the descriptions given of *Symbiotes communis* var. *cuniculi*.

FAMILY DERMANYSSIDÆ

Pneumonyssus duttoni, Newstead and Todd

Memoir xviii, Liverpool Sch. Trop. Med. p. 4 (with plate), 1905.

Since the publication (l.c.) of the description of the adult mite Dr. J. W. B. Hanington has been successful in discovering the earlier stages of this acarid, and a description of them is appended below:—

Ovum.—Rather narrowly ovoid; faintly yellowish-white and, as seen by transmitted light, rather granular in appearance.

Length ·32 mm.

Hexapod larva.—Short ovate, narrowed in front, widely rounded behind. Capitulum prominent. *Palpi* of five segments furnished with short slender hairs with the exception of the apical one, which has several long stiff hairs; basal segment broadest, but scarcely longer than the apical one; second, third and fourth shortest and nearly equal in length; formula (1, 5) (234); tip of the apical segment reaching to the middle of the third segment of the anterior legs. *Legs* directed forwards; all the segments with whorls of hairs near the articulations, those on the basal segments are mostly short and slender, while those on the remaining segments are long and stiff; tarsi longer than the two preceding segments; all with very long hairs, and a few short slender spines; claws simple, placed on a long pedicel which is much narrower at the articulation; pulvillus scarcely wider than the dilated claws, but the end extends beyond them.

Length ·50 mm.; width ·30 mm.

FAMILY TROMBIDIDÆ

The larvae of an acarid belonging to the genus *Trombidium* were found in considerable numbers attached to the naked skin on the muzzles of horses at Kasongo. They appeared to the unaided eye as minute crimson specks, and were evidently the cause of an intense eruption. The skin was pink, rough, and dotted here and there with tiny spots of dried blood; still attached to the skin or on slightly raised hairs were numerous profuse crusts of desquamated epithelium and dried serum. Although a careful search was made the parasites were not found elsewhere on these animals nor on any other host in that locality.

The larval forms of these acarids are well known for the intense itching and soreness which they cause by burrowing under the skin of man and other animals. It is generally an unnatural position for the mites, and as a rule they soon die; though one species which is often found on the ears of cats in this country (Great Britain) lives for many days, causing great annoyance to the infected animals.

The adult mite is not parasitic but predaceous, living on small insects and their ova. The only adult form collected in the Congo (Leopoldville, Oct.) was *Trombidium grandidissimum*, a large spider-like creature completely covered with a brilliant crimson pubescence which is so dense as to appear quite velvety in texture.

FAMILY IXODIDÆ*

The fourteen species of ticks here catalogued include two that are new and undescribed.

The only member of the Argasidae which we met with was *Ornithodoros moubata*; this important species has already been described and figured in the Report on the nature of Human Tick fever.† We therefore only add here a few additional notes on its bionomics.

A few hundreds of these ticks were brought to Liverpool in September, 1905; they have since been kept in an incubator at a temperature of between 19° and 22° C., where they have reproduced freely, but under these conditions the eggs take two or three days

* This collection was very kindly identified by Prof. G. Neumann.

† Liverpool School of Tropical Medicine Memoir XVII (Plates and map).

longer to hatch-out than was noted in the Congo. Many of the original ticks are still alive; they have of course been well and frequently fed. One female raised in the laboratory from an egg has now been under observation for 25 months; during this period she has moulted six times. This seems to be rather less often than is usual, since ten out of fourteen ticks raised from the eggs moulted six to nine times during the year. Not infrequently ticks do not seem to be able to shed their old skin, and die while moulting. As a rule the ticks would not feed properly more often than every seven to ten days. Ticks remained alive on several occasions without food for four months, and in one instance for over six months. Adult ticks caught before April, 1905, or their progeny, which have never been fed upon an infected animal, are still (November 22, 1906) able to infect susceptible animals by their bites.

Amblyomma hebraeum (Koch), var. *splendidum*, Gieb.

Forty-three males and eight females were taken from a Buffalo (*Bos nanus*) which was shot in a marsh near Tshumbiri. In life the ground colour of this beautiful tick is of a soft green, with brownish ornamentation; there is little or none of the irridescence so conspicuous in specimens preserved in alcohol.

Amblyomma variegatum, Fab.

On cattle, Kasongo (Feb.). Associated with *Hyalomma aegyptium*, *Rhipicephalus sanguineus* and *Margaropus annulatus*.

Amblyomma variegatum ?, Fab.

A single male was caught on a bovine at Kasongo (Feb.).

Hyalomma aegyptium, L.

Three females were caught on cattle at Kasongo (Feb.). They were associated with the preceding species.

Haemaphysalis leachi, And.

This tick is the recognised carrier of Malignant Jaundice (*Piroplasma canis*) in dogs.

Thirteen males and two females were taken from a leopard at Tshumbiri by the Rev. Billington (June); and Dr. Etienne sent a single specimen (host not mentioned) from Banana (Oct.).

Margaropus annulatus, Say.

Common on cattle at Kasongo (Feb.), Zambie and Coquilhatville. The specimens collected were all females.

Margaropus annulatus, var. *calcaratus*, Bir.

In all the active stages, on cattle at Coquilhatville.

Rhipicephalus bursa, Can. and Fanz.

Collected by the Chef de Poste on cattle at Nya Lukemba to the North of Lake Tanganyika. A single female was also caught on a bovine at Kasongo.

This species is the carrier of Carceag or Malignant Jaundice in sheep.

Rhipicephalus capensis, Koch

Eight females and four males were taken on cattle at Nyangwe.

Rhipicephalus nitens, Neumann

Locality:—One male and three females were taken from an antelope (*Tragelaphus scriptus*) shot at Kasongo (Feb.).

Rhipicephalus simus, Koch

This is said to be one of the carriers of *Piroplasma parvum*, Theiler.

Two males and one female taken at Kasongo (Feb.); and three males at Banana (Oct., Dr. Etienne). The name of the host was not obtained in either case.

Rhipicephalus sanguineus, Latr.

Locality:—At Banana (Oct.), collected by Dr. Etienne, host not named; at Kasongo, common on cattle; occurs in association with preceding species and *R. longus*.

In addition to the above, two species of Ixodidae new to science were also discovered. These are described by Prof. Neumann in the succeeding paper.

ERRATA.

Plate iv. For Tabanide read Tabanidae.
Map ii. Delete "(see pages)."

EXPLANATION OF PLATE I.

MIMOMYIA MALFEYTI. (Page 29.)

Fig. 1.—Head of female showing the character and distribution of the scales. × 25, about.

Fig. 2.—Tibial spines of male. × 75.

Fig. 3.—Genital armature of male (left half). × 75.

MIMOMYIA AFRICANA. (Page 28.)

Fig. 4.—Head of female showing the character and distribution of the scales. × 25 about.

ANISOCHELEOMYIA QUADRIMACULATA. (Page 32.)

Fig. 5.—Head of female showing the character and distribution of the scales. × 25, about.

Fig. 6.—Proboscis of the female. Enlarged.

NEOMELANICONION PALPALE. (Page 31.)

Fig. 7.—Head of male showing the character and distribution of the scales. × 25, about.

Fig. 8.—A few segments of the antennae of the male. Enlarged.

Fig. 9.—Male palpus. Enlarged.

ERETMAPODITES INORNATUS. (Page 12.)

Fig. 10.—Terminal segments of male abdomen. Enlarged.

CULEX PAR. (Page 25.)

Fig. 11.—End of Abdomen of female (ventral). Enlarged.

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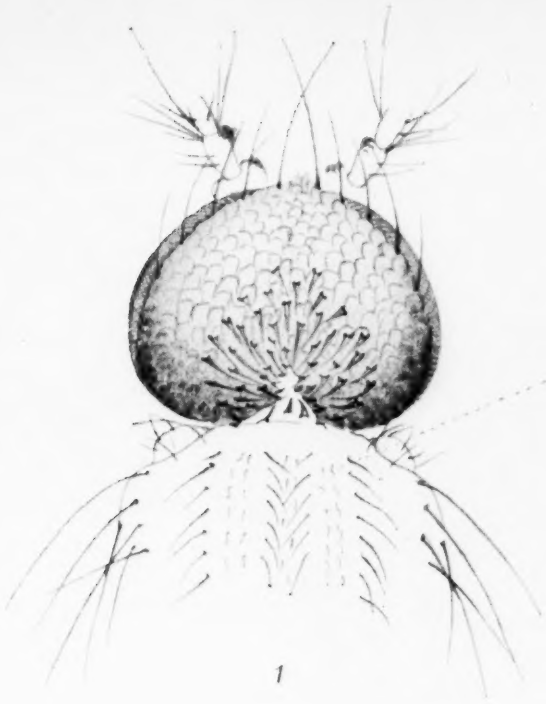

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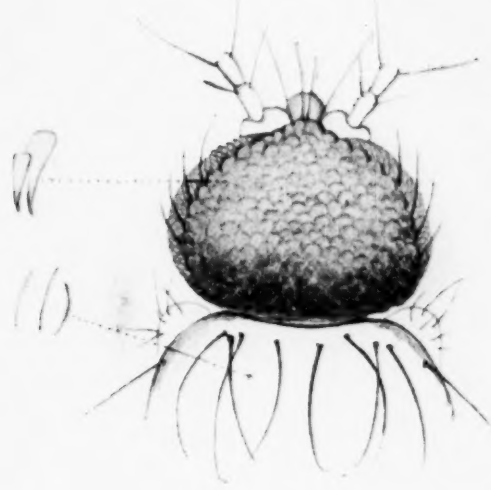

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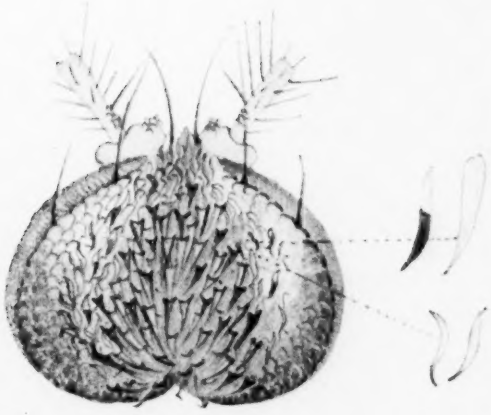

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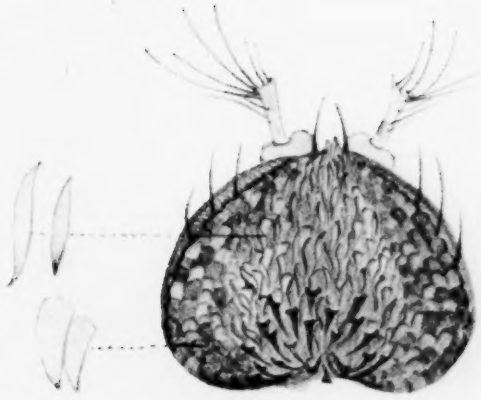

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EXPLANATION OF PLATE II.

BOYCIA MIMOMYIAFORMIS. (Page 34.)

Fig. 1.—Head of female showing the character and distribution of the scales. × 25 about.

Fig. 2.—Head of male showing the characters and distribution of the scales. × 25, about.

Fig. 3.—Palpus of male. Enlarged.

STEGOMYIA ALBOMARGINATA. (Page 16.)

Fig. 4.—Head of female showing the character and distribution of the scales. × 25, about.

STEGOMYIA LUTEOCEPHALA. (Page 15.)

Fig. 5.—Head of female showing the character and distribution of the scales. × 25, about.

DUTTONIA TARSALIS. (Page 18.)

Fig. 6.—Anterior tarsus of male. × 75.

Fig. 7.—Palpus of male. Enlarged.

Fig. 8.—Genital armature of male. × 25.

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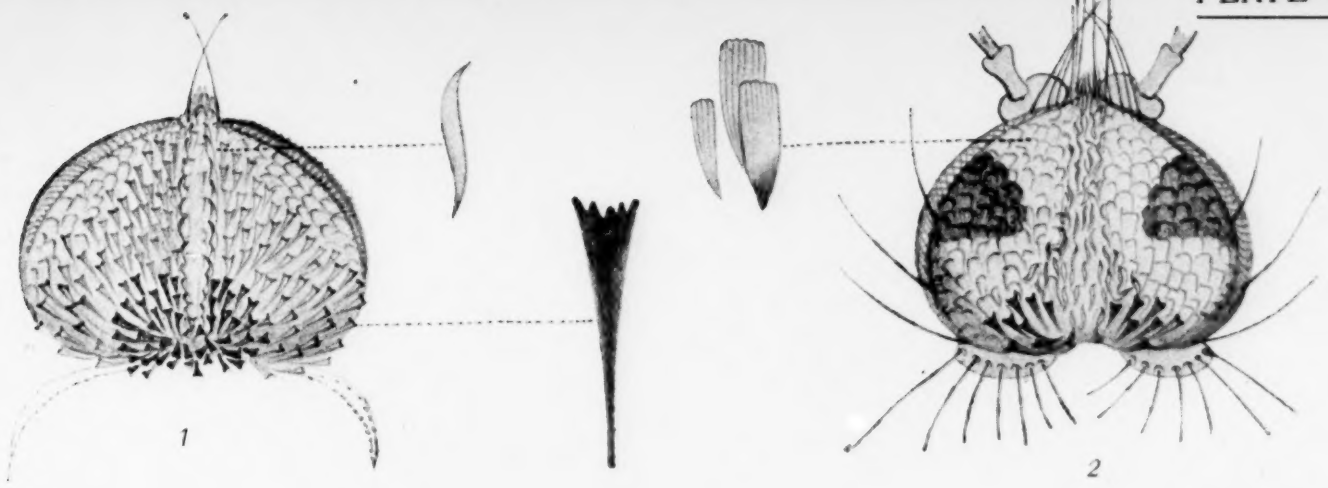
PLATE II.



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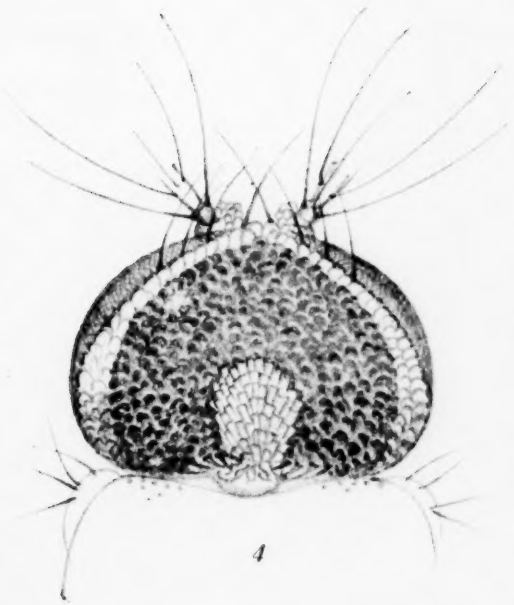

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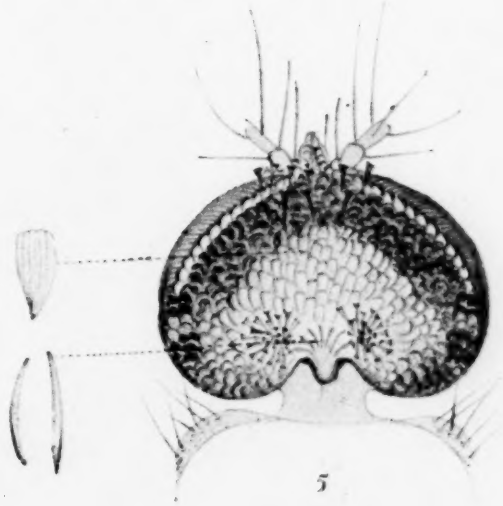

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EXPLANATION OF PLATE III.

TABANUS BILLINGTONI. (Page 46.)

Fig. 1.—Female with wings displayed. × $2\frac{1}{2}$.

STOMOXYS OMEGA. (Page 87.)

Fig. 2.—Female with wings displayed. × 4.
Fig. 3.—Male with the wings omitted. × 4.

STOMOXYS CALCITRANS. (Page 75.)

Fig. 4.—Female with wings omitted. × 4.
(In cutting away the background, the block-maker has inadvertently removed a portion from the left side of the abdomen.—R.N.)

GLOSSINA MACULATA. (Page 73.)

Fig. 5.—Female with the wings displayed. × 4.
Fig. 6.—Female with the wings at rest (profile). × 4.

GLOSSINA PALPALIS. (Page 57.)

Fig. 7.—Female in the act of parturition. × 4.
Fig. 8.—Puparium before the escape of the imago. × 4.
Fig. 9.—Puparium after the escape of the imago. × 4.

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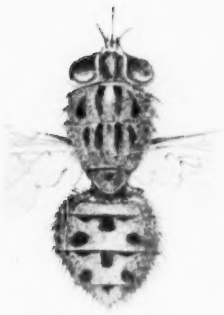

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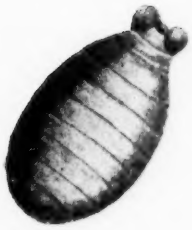

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EXPLANATION OF PLATE IV.

Fig. 1.—CHRYSOPS DIMIDIATUS. (Page 43.)

Fig. 2.—HAEMATOPOTA TRIMACULATA. (Page 42.)

Fig. 3.—HAEMATOPOTA DUTTONI. (Page 41.)

Fig. 4.—TABANUS DORSIVITTA? (Page 44.)

Fig. 5.—TABANUS UNIMACULATUS. (Page 46.)

Fig. 6.—TABANUS PAR. (Page 45.)

Fig. 7.—TABANUS PLUTO. (Page 45.)

Fig. 8.—TABANUS RUFIPES. (Page 45.)

Fig. 9.—TABANUS CANUS. (Page 44.)

Fig. 10.—TABANUS BILLINGTONI. (Page 46.)

Fig. 11.—TABANUS BILLINGTONI. (Page 46.)

Fig. 12.—TABANUS BILLINGTONI. (Wings displayed.) (Page 46.)

Fig. 13.—TABANUS TARSALIS. (Page 45.)

Fig. 14.—TABANUS FASCIATUS. (Page 44.)

Fig. 15.—TABANUS GABONENSIS. (Page 45.)

All the figures are the actual size of the originals, photographed direct.

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AFRICAN TABANIDE.

R. N. Photo.

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EXPLANATION OF PLATE V.

Illustrating Mr. Newstead's paper on "The Life-history of *Stomoxys calcitrans*, Linn." p. 75.

Fig. 1.—Eggs twice natural size.

Fig. 2.—View of the curved side of the egg. × 65.

Fig. 3.—Egg in semi-profile showing the deep spatulate groove. × 65.

Fig. 4.—Empty egg as seen in profile, with the semi-detached capsule at the anterior end. × 65.

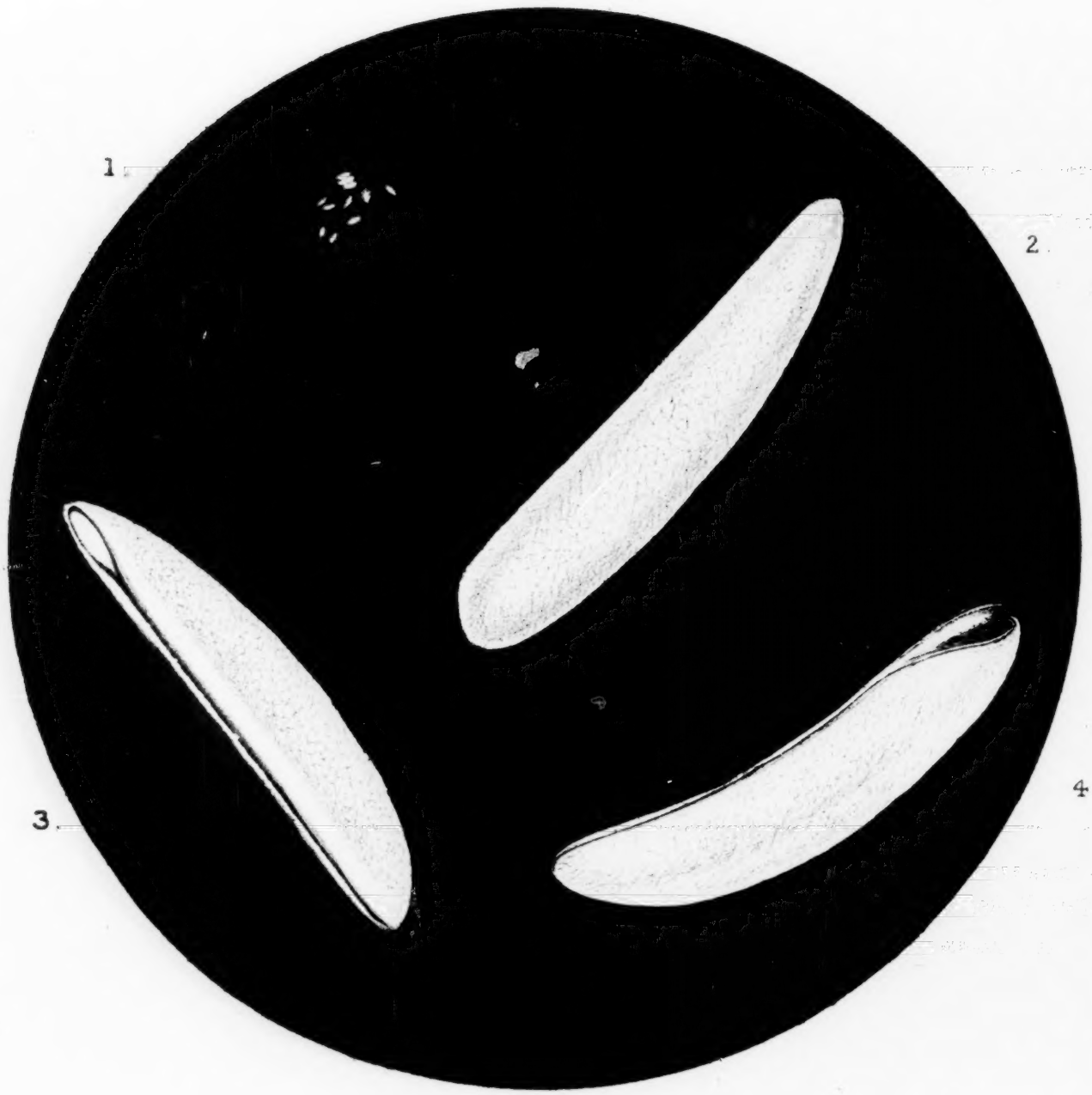
Fig. 5.—Dorsal view of larva showing the intestinal tract and course of the main tracheae. × 7.

Fig. 6.—Three terminal segments of the larva in profile, with the internal mouth armature: *an*, antennae; *m*, muscles; *ps*, perforated sclerite; *md*, mandible or great hook; *hs*, hypostomal sclerite; *cs*, cephalo-pharyngeal sclerites; *vt*, ventral tooth. × 60.

Fig. 6A.—Chitinised mouth armature dissected out. Reference letters as in the preceding fig. × 60.

Fig. 7.—Three terminal segments of larva, dorsal: *cst*, compound thoracic stigmen; *as*, trachea forming internal air sac. Other reference letters as in fig. 6. × 60.

Fig. 8.—Puparium or pupa. × 7.



R. Newstead, del. ad nat.

STOMOXYS CALCITRANS

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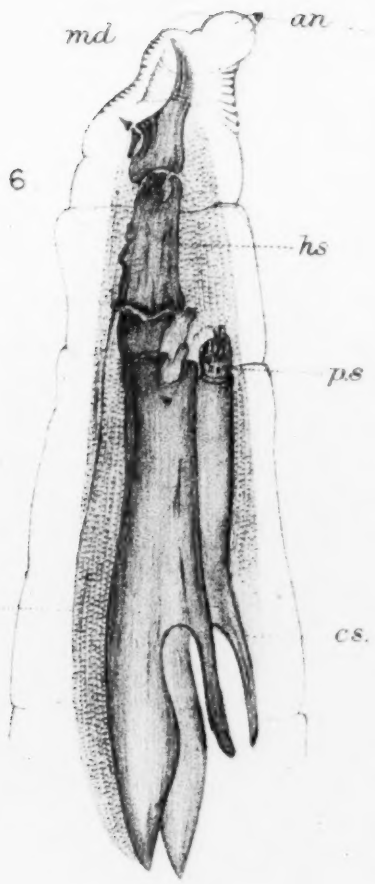

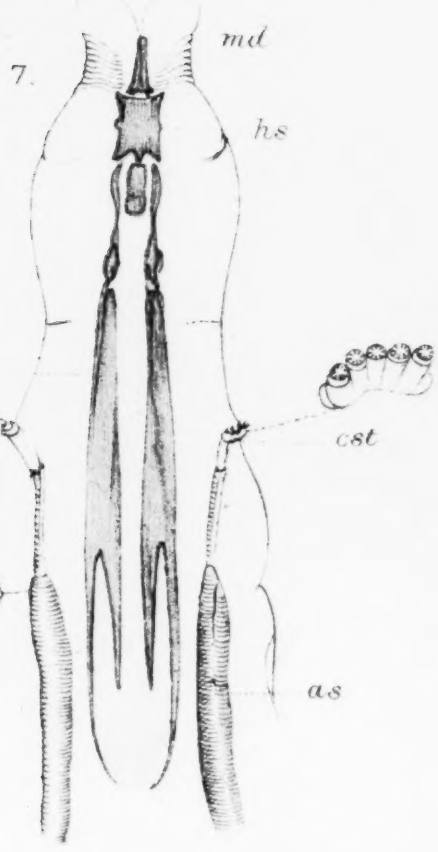

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EXPLANATION OF PLATE VI.

DERMATOPHILUS (SARCOPSYLLA) PENETRANS (Chiggoe Flea).
(Page 93.)

Fig. 1.—Plantar surface of human foot with chiggers *in situ*. Actual size.

(*aa*) Group of eleven females.

(*bbbb*) Isolated females.

(*cc*) Pits or cavities left after the removal of the females.

(*d*) Section of epidermis with two females *in situ*. (Lateral view.)

Fig. 2.—

(*a*) Larva showing the squamose character of the epidermis. × 60.

(*b*) Outline of a younger larva. × 60.

(*c*) Antenna of larva with its accompanying group of blunt spines. × 250.

(*d*) Mandibles of larva. × 250.

(*e*) ? Cephalo-pharyngeal plate of larva. × 250.

(*f*) Buccal spines of larva. × 250.

(*g*) Empty cuticles of ova. × 60.

Fig. 1. Human Foot with "Chiggers" in situ.

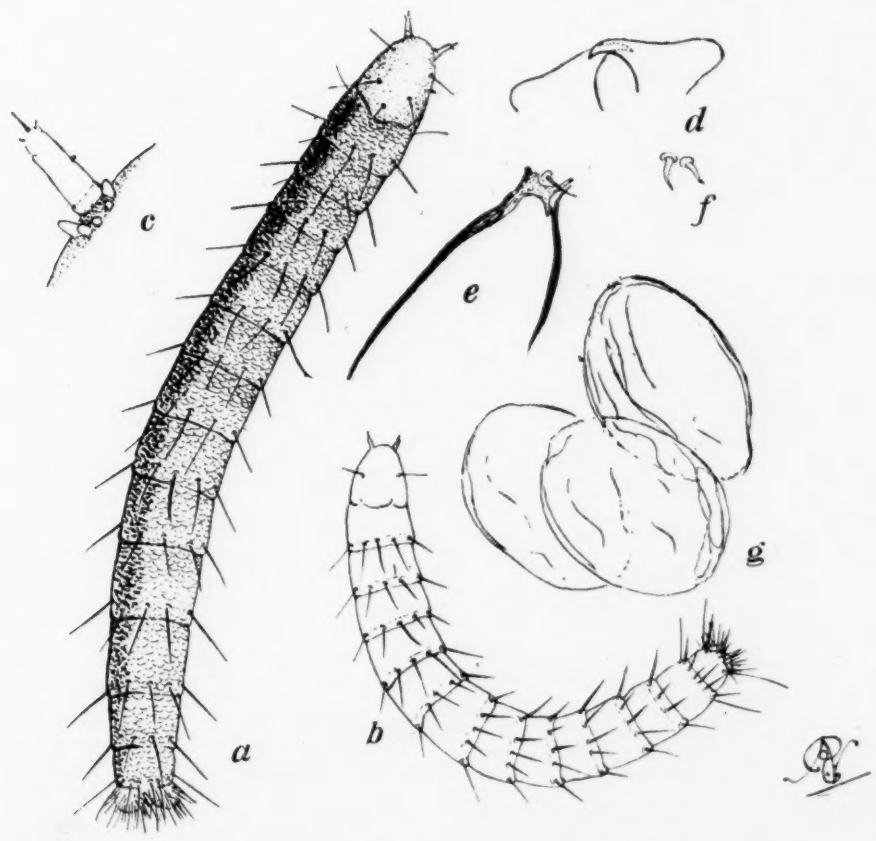

Fig. 2. Dermatophilus (Sarcopsylla) penetrans.
Details of Larva, etc.

R. Newstead, ad nat. del.

P. P. Press, Imp.

DESCRIPTION OF TWO NEW SPECIES OF AFRICAN TICKS

DESCRIPTION OF TWO NEW SPECIES OF AFRICAN TICKS

BY

G. NEUMANN

PROFESSEUR À L'ECOLE NATIONALE VÉTÉRINAIRE DE TOULOUSE

Rhipicephalus duttoni, n. sp. (Neumann)

MALE.—Body, narrow in front, broadest (1·85 mm.) a little posterior to the middle, length with rostrum 3·55 mm. *Scutum* slightly convex, chestnut-brown without spots, abdomen does not extend beyond its margins; cervical grooves are very broad, shallow, and form elongated depressions, they are not punctated and are continued posteriorly by a narrow superficial groove which extends beyond the middle point of the length; marginal grooves broad, shallow, slightly and finely punctated, commencing almost immediately behind the eyes and terminating in the groove which separates

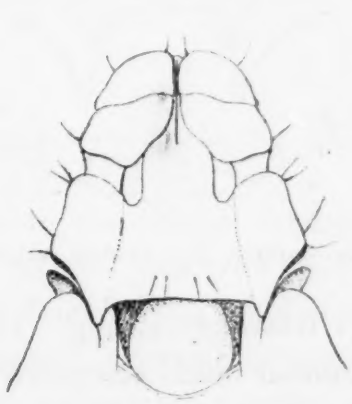

FIG. 22.—*Rhipicephalus duttoni*, ♂. Rostrum. × 45.

the two last from the following festoon; punctations irregular, coarsest in front, fine and superficial over the remainder of the surface; behind are three wide, shallow, unpunctated longitudinal grooves, the middle one being the longest; festoons longer than they are broad, slightly punctated, normal. *Eyes* flat, yellowish, large, marginal. *Ventral surface* reddish-brown, covered by rather long and abundant whitish hairs. *Anus* anterior to the middle of the

length of the adanal shields; adanal shields have the shape of a scalene triangle and so form a long internal posterior spine (the internal edge is longest, it is rectilinear in its anterior half but is concave behind; the external edge is slightly convex; the posterior edge is concave and bordered by punctations); the outer shields are replaced by a prominent, non-chitinous fold; no caudal prolongation but a chitinous thickening on the median festoon. Peritremes narrow, whitish, comma-shaped with the point bent back towards the dorsal surface. *Rostrum* 0·6 mm. long, dorsal base almost twice as broad (0·6 mm.) as long, lateral angles at about the middle of the length, posterior angles quite prominent. Hypostome very slightly spatulated, has six rows of teeth. Palps as broad as long, flattened dorsally; second segment scarcely longer than the third and retracted into a blunt point dorsally at its

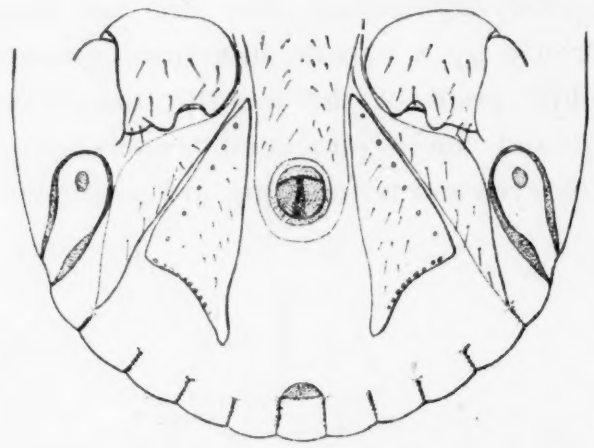

FIG. 23.—*Rhipicephalus duttoni*, ♂. Ventral surface of posterior extremity. × 33.

posterior border. *Legs* relatively strong. Coxae covered with long white hairs; anterior summit much elongated and conspicuous on the dorsal surface as an auricle, two very long spines; on the posterior borders of the second and third an external spine, flat, as broad as long; fourth divided at posterior border into two broad flat spines. Tarsi of medium size, have two terminal successive spurs; caruncules large.

FEMALE unknown.

A single male was taken on a bovine at Zambie together with females of *Margaropus annulatus*.

This species is dedicated in honour of our late colleague Dr. J. Everett Dutton.

Rhipicephalus longus, n. sp. (Neumann)

MALE.—Body narrow in front, sides subrectilinear, length with rostrum 4·1 mm.; broadest (2·15 mm.) towards the posterior third. *Scutum* almost flat, dark chestnut-brown, without spots; along the posterior festoons the abdomen extends beyond its margin; cervical grooves, very short and deep; marginal grooves deep, narrow, each occupied by a row of punctations, commencing a little behind the eyes, ending at the posterior border of the penultimate festoon, and are continued forward, and especially inwards, by a row of coarse, scattered punctations; punctations irregular, abundant in the space enclosed between the marginal grooves and the punctated anterior prolongation; they are regular in size and distribution anteriorly in

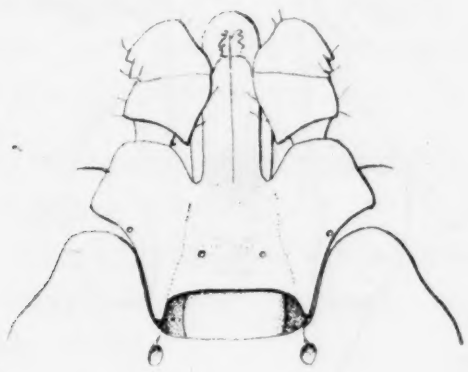

FIG. 24.—*Rhipicephalus longus*, ♂. Rostrum. × 45.

the space corresponding to the female scutum, and they exist with the same appearances in the posterior part of the scutum, but they become scanty and finer in the neighbourhood of the marginal grooves and their punctated anterior prolongations; the marginal border is smooth save in the scapular angles which are hollowed by six to eight larger punctations; posterior festoons longer than they are wide, almost smooth, followed by short abdominal festoons. *Eyes* flat, yellowish, of medium size, marginal with a coarse tangential punctation at the internal edge. *Ventral surface* reddish brown, with a few short hairs. *Anus* at about the middle of the length of the adanal shields; adanal shields long, semilunar (the inner edge concave, the external and the posterior convex) with fairly heavy punctations on their surface; external shields replaced by a prominent non-chitinous fold; festoons subrectangular, sharply defined; no caudal prolonga-

tion. Peritremes whitish, broad, comma-shaped, with point curved towards the dorsal surface. *Rostrum*, length 0·7 mm., dorsal base more than twice as broad as it is long, lateral angles very prominent at about the anterior third of the length, posterior angles quite prominent. Hypostome slightly spatulated, with six rows of teeth. Palps hardly longer than they are broad, flattened dorsally with the second segment a little longer than the third and shortened in a blunt point posteriorly at its inner border. *Legs* relatively strong. Coxae with long scattered hairs; first with anterior summit not prolonged nor visible on the dorsal surface, has two very long spines;

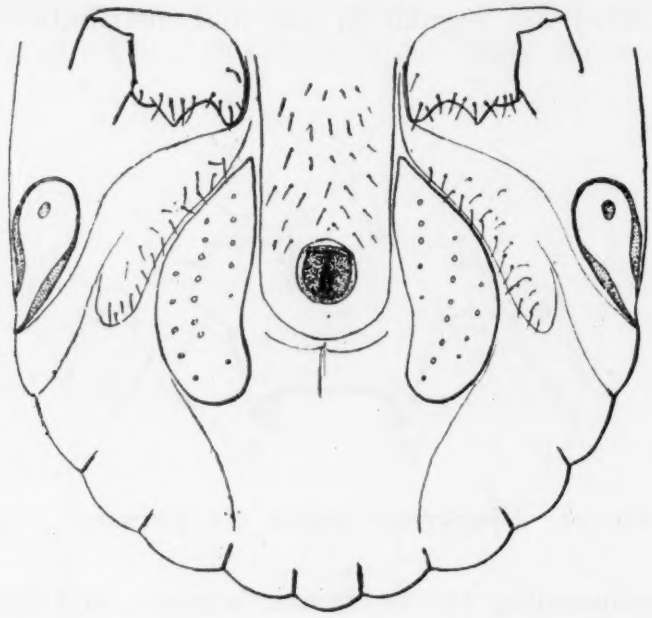

FIG. 25.—*Rhipicephalus longus*, ♂. Ventral surface of posterior extremity. × 33.

second, third and fourth with posterior border incurved to form two short spines, the inner being wide, flat and blunt, the outer narrow and sharp. Tarsi of medium length with two terminal successive spurs; caruncules medium size.

FEMALE unknown.

Locality:—Diagnosis established from a male taken on a bovine at Kasongo (April).

Rhipicephalus duttoni and *R. longus* are placed in the following manner in the table of differentiation of males of the various species of *Rhipicephalus*.

1. Eyes flat.—2.
   Eyes prominent.

2. Marginal groove well marked.—3.
   Marginal groove absent.

3. Dorsal scutum uniformly brown.—4.
   Dorsal scutum black and white.—*R. pulchellus.*

4. Adanal shields not prolonged to a point (posterior border straight or convex).—5.
   Adanal shields prolonged in one or two points (posterior border concave).—12.

5. Posterior border of the body not prolonged nor furnished with a caudal prolongation.—6.
   Posterior border of the body furnished with three prolongations.—*R. supertritus.*

6. Adanal shields triangular or subtriangular (internal edge straight or slightly concave).—7.
   Adanal shields sickle-shaped (their inner border very concave, the two others forming a single regular curve).—*R. haemaphysaloides.*

7. Marginal groove deep, long, commencing near the eyes.—8.
   Marginal groove superficial, short, commencing at the middle of the length of the body.—*R. ziemanni.*

8. Dorsal scutum with scattered punctations.—9.
   Dorsal scutum with numerous, serried, punctations.

9. Dorsal scutum with unequal, very evident, irregularly distributed punctations.—10.
   Dorsal scutum with large, equal punctations arranged in longitudinal lines with or without additional fine and hardly visible punctations.—*R. simus.*

10. Coxae I, with or without a short prolongation in front, not visible from the dorsal surface.—11.
    Coxae I, with a long anterior prolongation, visible from the dorsal surface.—*R. appendiculatus.*

11. Dorsal scutum with mixed punctation, regularly distributed.—*R. sanguineus.*

    Dorsal scutum with medium-sized uniform punctations between the marginal grooves, rare in their neighbourhood, none on the edge, large ones on the scapular angles.—*R. longus.*

12. Anal shields with a single (or principal) internal point.—13.

    Anal shields with an external point.—*R. lunulatus.*

13. Coxae I, without visible prolongations from the dorsal surface ; adanal shields with two points.—*R. armatus.*

    Coxae I, with prolongations visible from the dorsal surface ; adanal shields with one point.—*R. duttoni.*

ON SOME PARASITES IN THE MUSEUM OF THE SCHOOL OF TROPICAL MEDICINE, LIVERPOOL

ON

SOME PARASITES IN THE MUSEUM OF THE SCHOOL OF TROPICAL MEDICINE, LIVERPOOL

BY

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WITH A CONTRIBUTION ON

A CASE OF DISTOMIASIS OF THE LIVER AND THE RECTUM

BY

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During a visit I recently paid to the School of Tropical Medicine in Liverpool Dr. STEPHENS showed me a number of parasites which had been sent to the Museum of the School from various places. Unfortunately, some of the bottles bore no indication whatever as to the locality from which the specimens were obtained; others were labelled, but an inspection of their contents with the naked eye or a pocket lens raised within me strong doubts as to the correctness of the respective identifications. To make things sure Dr. Stephens kindly agreed that I should take with me, of those forms of which several were present, a few specimens for a more careful examination and possible identification of the species. The results of this investigation are given in the following pages.

Fasciolopsis buski (LANK.), 1857.

About a dozen specimens from Hong-Kong in a jar labelled "Distoma crassum." Rather large and fleshy, apparently some what contracted worms of about 30 mm. in length, 13 to 16 mm. in breadth and nearly 4 mm. in maximum thickness. Body moderately elongated, rather regularly oval, its surface marked with numerous fine transverse ridges brought about by contraction. Both suckers very close to the anterior end of the body; opening of the anterior sucker

minute and completely ventral, opening of the posterior sucker very wide, transversely oval, about 2 mm. in its largest diameter. The same is the average distance between the centres of the two suckers. In some cases the part of the body containing the anterior sucker was found separated from the rest in the shape of a minute but quite distinct cone resembling that which characterises the members of the genus *Fasciola*. Immediately in front of the ventral sucker there is a transverse slit indicating the position of the genital aperture. All round the margin of the body, the colour of the worms is considerably duller than in the middle and in most cases this duller tint projects twice on each side in an angular fashion into the lighter central area, this latter thereby assuming the shape of three successive but incompletely separated discs. All these characters discernible by naked eye inspection suggested *Fasciolopsis buski* (LANK.). A comparison of the internal organisation—so far as this could be made out from cleared entire individuals—did not reveal any noticeable difference from the description recently given of the species by ODHNER (1902). The determination *Distoma crassum* is therefore correct, for the name *Distoma crassum* (COBB), 1877, is only a synonym of *Fasciolopsis buski* (LANK), 1857.

Distoma pancreaticum (JANSON).

A bottle from Hong-Kong, without label, contained a number of medium-sized flukes which in their outward appearance recalled the pancreatic fluke of ruminating animals in Eastern Asia. On closer inspection it could be seen even with the naked eye that there were two varieties present in this material, a larger form with very wide and projecting suckers and a somewhat smaller in which the suckers were well developed also, but much smaller and less prominent. Both varieties were represented by evidently completely mature individuals; there were, in addition, numerous young specimens of different size of the second variety, but no immature specimens of the first. Two specimens of the first variety and four adults of the small kindly given to me by Dr. STEPHENS form the basis of the present description.

After clearing, the chief points of their internal organisation could fairly well be made out in entire specimens; the details observed were in full agreement with the descriptions given of the *Distoma*

pancreaticum by the earlier writers. There were, however, between the two varieties in addition to the differences mentioned above in the size of the suckers several other slight internal discrepancies which leave no doubt that the two forms must be considered as two distinct species. Both are closely allied to each other and members of the same natural genus. The generic name hitherto usually adopted for *Distoma pancreaticum* is *Dicrocoelium*; indeed, the principal features of the anatomical structure are the same in *Distoma pancreaticum* and *Dicrocoelium lanceatum* (ST. and HASS.), the type species of the genus. But besides this similarity in the main structure there are also certain differences which to my mind forbid placing *Distoma pancreaticum* in the genus *Dicrocoelium itself*, that is to say as it is represented by its type *lanceatum*. One of the most conspicuous of these differences lies in the thickness and the considerable breadth of the body which latter allows the testicles to take a distinctly lateral position at about the same level, whereas in *Dicrocoelium* sensu strictiori, owing to the narrow spindle-shaped outline of the body, the testicles are placed obliquely one behind the other. In *Lyperosomum* which is also closely related to *Dicrocoelium* the two cross diameters are still more reduced, the members of this genus presenting to the observer an almost filiform body of about equal breadth and thickness in which the genital glands are found in a straight line one behind the other. In addition to the peculiar shape of their body the two *Distoma pancreaticum* differ from *Dicrocoelium* by the more complicated structure of their excretory vesicle and the stronger development of their copulatory organs. On the whole, therefore, there is sufficient reason for creating a new genus for the two forms under discussion.

The question as to the correct denomination of the *species* was somewhat difficult to decide. *Distoma pancreaticum* was discovered in Japan, and became first known in Europe during the Paris Exhibition in 1889, where the Agricultural School of Komaba exhibited a series of parasites among which there was a "*Distoma pancreaticum* from the pancreatic duct of sheep," and a "*Distoma pancreaticum* var. from the pancreas of sheep." The new parasite was referred to in subsequent years by RAILLIET (1890) and JANSON (1893 and 1895); the respective papers deal with the anatomical structure and the pathological significance of the parasite, they emphasise its

resemblance to *Dicrocoelium lanceatum* but do not—so far at least as I can personally consult them at present—contain any decisive statement from which one or the other of the two Hong-Kong species mentioned above might be recognised. In 1897, GIARD and BILLET, apparently ignorant of the existence of the *Distoma pancreaticum*, described a *Distoma coelomaticum* which the latter author had found plentifully in the pancreas of an ox killed at the slaughter-house of Cao-Bang (Tonkin); there had at first been some mistake as to the habitat of the parasite—which led to the denomination *coelomaticum* —but this mistake was corrected afterwards upon a suggestion of RAILLIET. The details given in GIARD and BILLET'S description are sufficient to show that *Distoma coelomaticum, also* structurally resembles *Dicrocoelium lanceatum* and *Distoma pancreaticum*, but there is again no statement which would be indicative of one of our two species in contradistinction from the other.

The latest description of *Distoma pancreaticum* is given by RAILLIET and MAROTEL in 1898. The specimens upon which their paper is based were collected by Dr. GOMY, a French veterinary surgeon, from the pancreatic ducts of cattle and Indo-Chinese buffaloes in Saigoon (Cochin-China), a locality therefore which is not so far distant from the place at which GIARD and BILLET'S material was taken. This time, the description is more complete; the worms are said to measure from 7 to 10 mm. in length and from 4 to 4·5 mm. in breadth; their suckers are of about equal size, the posterior of 0·75 to 0·95 mm. in diameter being only slightly larger than the anterior which presents a diameter of 0·7 to 0·9 mm. The distance between the two suckers varies from 1·3 to 2·4 mm., that is to say, it amounts to about a quarter of the total length of the body. As will be more fully seen hereafter, all these measurements apply very well to the smaller of the two Hong-Kong species and among the antomical details given by the authors there is none moreover which would not quite well fit in with its organisation. I thus think it perfectly safe to assume that this smaller Hong-Kong species is the same as the *Distoma pancreaticum* described by RAILLIET and MAROTEL in 1898 from Saigoon cattle. But RAILLIET in the same paper (p. 32) also states that he has satisfied himself *de visu* of the specific identity of this Cochin-Chinese pancreatic fluke with the parasite found in Tonkin by BILLET. This latter parasite had first

been described under the name of *Distoma coelomaticum* and the question now arises: is this *Distoma coelomaticum* of Indo-China really the same form as the *Distoma pancreaticum* of Japan? If this were so, then the smaller Hong-Kong form would have to be identified as the genuine *Distoma pancreaticum*, the name *coelomaticum* would have to be definitely dropped as a synonym and a new specific name would have to be given to the larger Hong-Kong species with the strongly developed suckers.

As I have already pointed out, the data given in the printed description of the original Japanese pancreatic fluke are not sufficient to decide the question. I possess, however, in my collection a number of specimens of *Distoma pancreaticum* which I owe to the kindness of Professor JANSON, of Tokio. They were collected from the pancreatic ducts of cattle in Japan and I think there can not be any reasonable objection to the assumption that they are specifically the original Japanese *Distoma pancreaticum*. It is true that the first specimens of this species exhibited in Paris were labelled as collected from sheep, but I am not inclined to attribute a great importance to this difference in the host, because it is a well-known fact that many parasites of cattle and buffaloes occur not only in sheep but in other ruminating animals also. A comparison of this Japanese material has now shown, first, that there is only *one* species present in it and, second, that this species is identical with the larger species of the Hong-Kong material. On the ground of these facts I feel justified in considering this latter species as the genuine *Distoma pancreaticum* of JANSON; for the smaller species I readopt the name *coelomaticum* of GIARD and BILLET, the suppression of which was, in the sense of the nomenclatural rules, a mistake based upon an erroneous identification of the species.

Eurytrema, nov. gen., *Dicrocoeliidarum*,

Differs from *Dicrocoelium* especially by the following particulars: Body rather thick and considerably broadened, with the exception of the hindmost part which retains its original shape and appears as a small triangular appendage sharply set off from the rest of the body; it is repeatedly referred to in the descriptions of the earlier authors as resembling in outline the cephalic part of *Fasciola hepatica*. Suckers very large and prominent, the oral sucker completely ventral and

surmounted by the anterior margin of the body. Excretory vesicle composed of a median stem which divides into two at about the middle of the total length, the transverse branches, in the neighbourhood of the intestinal caeca, dividing again each into an anterior and a posterior branch which run for the greater part outside of the intestinal caeca, and terminate in the neighbourhood of the anterior and posterior extremities of the body. Testicles lateral, at about the same level but far apart from one another. Copulatory organs well developed; cirrus pouch thick, almost cylindrical, containing a long but rather thin seminal vesicle and an equally long and thin ejaculatory duct which both describe a number of coils within the pouch. Vagina corresponds in length and arrangement to the ejaculatory duct. Structure of the remaining organs as in *Dicrocoelium*.

Type: *Eurytrema pancreaticum* (JANSON) 1889.

Eurytrema pancreaticum (JANSON),

(nec *Dicrocoelium pancreaticum*, RAILLIET and MAROTEL, 1898).

The two Hong-Kong specimens at my disposal are fairly well extended and measure 13 and 14 mm. in length; their maximum breadth of 6·5 and 7 mm. is reached immediately behind the ventral sucker. Thence the body narrows more quickly towards the anterior extremity than posteriorly but ends rather truncatedly owing to the large size of the oral sucker above which the margin of the body projects in the shape of a thick lip. The small tongue-like appendage of the posterior end is very conspicuous. The thickness amounts to almost 2 mm. in the median line of the anterior half, but gradually decreases towards the edge. The Japanese specimens are somewhat more contracted and thicker throughout, varying in length between 9·5 and 16 mm., in breadth between 5·5 and 8·5 mm.—in such a way that the longer specimens are generally less broad and vice versa. There are, however, also two apparently mature individuals 9·5 and 10 mm. long, but only 5·5 mm. broad. Skin, thin, without armature. Suckers very large and prominent, the anterior one with an average diameter of 2·1 mm., noticeably larger than the ventral which presents a diameter of 1·45 to 1·65 mm., but is in some specimens found more or less everted reaching thereby a size of 1·9 mm. In the two smallest specimens mentioned above the ratio of the suckers is 2·1 to 1·4 and 1·8 to 1·3 mm. respectively. They are, therefore, even in these

smallest specimens considerably larger than in the *Distoma coelomaticum* of the same size. The ventral sucker is always found near the end of the anterior half of the body; the distance between the centres of the two organs varying in the larger specimens from 4·5 to 5·7 mm. and being in the two small specimens 3·9 and 3·3 mm., that is to say it amounts to at least a third and is usually but little less than half of the total length. The genital opening has its position about halfway between the two suckers and is sometimes found slightly raised above the level of its surrounding. In one of the specimens the penis is seen everted, apparently to its full length, for the larger part of the seminal vesicle is located in it; it represents an organ 3·4 mm. in length and at its base 0·37, at the free end 0·24 mm. wide. Its surface is smooth.

The internal anatomy agrees with the descriptions given by the earlier writers. The small pharynx of 0·47 mm. length and 0·54 mm. width is usually so much displaced dorsally that it is not visible from the ventral aspect; behind it there follows a short oesophagus which, as a rule, runs straight down towards the ventral side and may thus more or less entirely disappear from view. The intestinal caeca of proportionally insignificant calibre quickly diverge and follow a zigzag course which becomes especially pronounced behind the testicles. Their blind terminations lie about as far as the length of the tongue-like end-portion of the body in front of the base of that portion and usually not quite on the same level, the left branch being as a rule (but not always) the shorter. The full extent of the excretory vesicle could not be made out in any of the specimens at my disposal, owing to the thickness of the body and the strong development of the uterine coils. The main parts described in the generic diagnosis are usually seen and followed without much difficulty; but, in addition to them, one may observe in some places isolated portions of similar tubes which seem to be ramifications of the anterior and posterior lateral branches. There are two running forwards on either side of the ventral sucker, and two running backwards and towards the median line amidst the uterine coils in the posterior half of the body Although they appear as if they were parts of the excretory vesicle, I cannot tell with certainty whether or not they really belong to that organ. The terminations of the main anterior branches of the vesicle lie close to the oral sucker at about the level of its centre, those of the

posterior branches at, or slightly in front of, the two notches which separate the terminal triangular tongue from the rest of the body.

The position of the genital aperture has been given above; it lies always a little behind the bifurcation of the intestine. The thick muscular cirrus pouch, usually somewhat curved in the shape of a sausage, presents a length of 2·2 to 3 mm. and an average width of 0·6 mm. Its posterior end rests upon the anterior slope of the ventral sucker, but there are some variations in its length in connection with the contraction of the body and the fulness of the seminal vesicle. This latter occupies the posterior half of the pouch, describing, within it, a proportionally large number of small coils. The pars prostatica is short and the number of glandular cells surrounding it limited. The ejaculatory duct is at first rather narrow, but widens somewhat towards its free end; its coils are proportionally numerous also. The dimensions of the evaginated penis have been given above. The fairly large testicles are normally found at the same level somewhat behind the ventral sucker, but may in strongly contracted specimens be more or less completely shifted to its sides. They have in the greater number of my specimens a distinctly lobed shape, but exceptionally the lobes may be so short and broad that the glands appear to possess a merely notched outline. The number of lobes (or notches) seems to be constantly four for one (usually the left) and five for the other testicle. These conditions are inverted in the cases of "sexual amphitypia" which are not unfrequently met with in this as well as in the following species.

The small ovary is usually found a short distance behind the testicles, on the left—in cases of sexual amphitypia on the right—side of the body. It has in all the specimens with lobed testicles a distinctly lobed shape also, the number of lobes being three. In those specimens, on the other hand, in which the testicles show the notched outline only, the ovary, too, loses its lobed outline more or less and appears compact with some irregular bulgings of its surface. The oviduct starts from its near side and almost immediately enters into a well-developed shell-gland which in cleared specimens appears as an opaque sharply outlined body by the side of the ovary and close to the ventral surface. There is also a fairly long LAURER'S canal of an average diameter of 0·04 mm. which opens to the outside in front of the ovary. It carries a small seminal receptacle which I have never been able

to discover in entire specimens, but clearly saw in a series of sections. The receptacle represents in the sectioned specimen a globular body of about the same size as the ovary (0·4 mm. in diam.) and lying close to its dorsal surface. It communicates with the LAURER'S canal by a distinct thin duct, but does not contain many spermatozoa, a fact which renders the seminal receptacle very transparent in unstained specimens. This insufficient filling in combination with the particular position of the seminal receptacle is obviously the reason why it escapes observation in entire worms.

The yolk-glands are only little developed; they are composed of rather numerous acini of a slender club shape collected into more or less distinct groups, the number of which seems to vary between ten and twelve. In extended specimens the groups lie in a nearly straight line one behind the other and are fairly well discernible; in contracted individuals they become more closely packed together and some of them—especially those in the middle—may be shifted laterally in such a way that for a certain distance there appear to be two irregularly alternating rows of groups. In this latter case some of the follicles are pushed below the intestinal caeca, otherwise, the yolk-glands lie as a whole between these and the body margin, usually the gland on the side of the ovary somewhat farther in front than that of the opposite side. Their extent varies a little individually and with the contraction of the body. In the greater number of specimens they commence somewhere at the outer border of the testicles and their posterior ends lie halfway between the posterior border of the ventral sucker and the base of the tongue-like end-portion of the body, but may in strongly contracted specimens also be found further forward. The transverse yolk-ducts originating, on each side, by the union of an anterior and a posterior tributary arise from the glands at about their middle; they join near the ovary (the left transverse yolk-duct being thus shorter than the right) and then enter the complex of the shell-gland from behind. There is no distinct widening of the unpaired part of the yolk-duct into a yolk reservoir. The coils of the uterus are very numerous but do not, as a rule, appear to the observer in the shape of regular loops, but rather as loose tubes branching and sometimes anastomising in an irregular manner. Occasionally only, i.e. in individuals in a certain state of contraction, one may perceive the picture which is so characteristic of the uterus of *Dicrocoelium*

lanceatum and in which the descending and ascending stems of the uterus cover each other in such a way as to appear as a straight main stem from which lateral ramifications are branching off. As far as the branches of the intestine extend backwards, it is only exceptional to see one or the other uterine coil cross them towards the margin of the body; behind their blind ends the coils extend much nearer to the margin and the terminal small triangular appendage is, in perfectly mature specimens, almost completely filled with them. Anteriorly the coils are limited by the testicles and the ventral sucker; the uterus then passes between the latter and the right testicle (i.e. the testicle opposite the side of the ovary) and in front of this still forms some small convolutions before entering into the long and thin, but rather muscular vagina which accompanies the cirrus pouch while describing a number of narrow coils.

The eggs have a striking likeness to those of *Dicrocoelium lanceatum*; they are slightly larger than these showing, on an average, a length of 0·05 mm. and a width of 0·034 mm.—but apart from that, they present the same oval shape and the same thick shell of deep brown colour as these and contain, in addition, a miracidium which, when fully developed, shows the same two enigmatical strongly refractive bodies which are peculiar to miracidia of *Dicrocoelium lanceatum*.

Eurytrema coelomaticum (GIARD and BILLET) 1892.

(Synonym: *Dicrocoelium pancreaticum* RAILLIET and MAROTEL, 1898).

The largest specimens at my disposal attain a length of 10 mm., and a maximum breadth of 5·5 mm.; younger (immature) specimens measure 7·5 by 4, 7·5 by 3·5 mm., &c. The outline of the body is almost regularly oval, and there is no marked narrowing towards the anterior extremity. The triangular terminal portion ("languette triangulaire" of RAILLIET) is fairly conspicuous. The maximum thickness of the body does not seem to exceed 1 mm. In the four large (mature) specimens which I have for examination the oral suckers present diameters of 0·95, 0·88, 0·85 and 0·83 mm., the ventral suckers diameters of 0·98, 0·91, 0·85 and 0·83 mm. respectively. These

measurements agree fairly well with those given by RAILLIET who, in the Saigoon specimens, found the oral sucker to vary in diameter from 0·75 to 0·93 mm., the ventral sucker from 0·7 to 0·9 mm. The distance between the centres of the two organs which RAILLIET gives as 1·3 to 2·4 mm. is in the four above mentioned specimens, 2·5, 2·97, 2·7 and 2·72 mm.; the suckers are therefore, in *Eurytrema coelomaticum*, proportionately much nearer to each other than they are in *E. pancreaticum*, for the ventral sucker lies in the former species with the greater part of its mass still in the anterior third of the body and the distance between the two always remains *less* than a third of the total length. The size and relative position of the suckers represent, apart from the general shape of the body, the most conspicuous of the specific characters of *Eurytrema coelomaticum*.

The internal anatomy has been so fully described by RAILLIET and MAROTEL that I have nothing of importance to add; it is moreover essentially the same as that of *E. pancreaticum*, as may be seen by a comparison of the data given above with the description of the French authors. There are nevertheless the following differences in detail which I am inclined to consider as of specific value, although some of them are not absolutely constant. In *E. coelomaticum*, the genital glands never present the lobed appearance of those of *E. pancreaticum*, but always show a compact shape with irregular bulgings of their surface instead of lobes; the apparent rule that one testicle has four the other five bulgings seems however to be preserved here too. The yolk-glands which, in *E. pancreaticum*, were composed of ten to twelve groups of follicles, show in *E. coelomaticum*, only six to eight; the glands are therefore as a whole shorter than in the preceding species and they also begin somewhat farther backwards, viz. at the same level with the *posterior* margin of the testicles. In spite of that, their posterior terminations appear much more distant from the end of the body than in *E. pancreaticum*, a fact due to the considerable difference in the relative position of ventral sucker and genital glands in the two species. In *E. coelomaticum*, finally, it is not so uncommon to see one or the other uterine coil pass beyond the intestinal branches laterally.

The eggs, in shape, aspect and structure of the miracidium, closely resemble those of *E. pancreaticum*, but are somewhat smaller, namely

0·042 to 0·046 mm. long and 0·023 to 0·027 mm. wide. This size, by the way, is the same as that of the eggs of *Dicroc. lanceatum.*

Gastrodiscus secundus n. sp.

A small jar containing about a dozen specimens and a label on which there was written in pencil: "Gastrodiscus Sonsinonis Cobb. from mule." They were collected by GILES in Assam, who states that they are also found in equines throughout India. In their external appearance they absolutely resembled the African *Gastrodiscus aegyptiacus* (COBBOLD) 1877 (= *Diplostoma aegyptiacum* COBBOLD 1877, = *Gastrodiscus polymastos* LEUCKART 1877, = *Gastrodiscus sonsinoi* COBBOLD 1877), with the sole difference that all of them were noticeably *smaller.* Three specimens at present at my disposal show a length of 7, 8 and 8 mm., and a maximum breadth of 4·5, 5 and 5 mm.; the corresponding measurements in *Gastrodiscus aegyptiacus* being 10 to 13 mm. and 7 to 9 mm.

The body shows the characteristic division into two parts: the cylindrical or slightly depressed cephalic portion, and the broad oval disc, at the end of which the second sucker is placed. In the specimens under discussion the former is about 1·35 mm. long and at its base 1·6 mm broad. Near its top, there appears on the ventral surface the mouth opening, about 0·37 mm. wide. In its neighbourhood the cuticle shows a large number of small circular or oval thickenings which project externally in the shape of small tubercles. They are apparently tactile papillae similar to those found round the mouth opening in allied forms. Behind the mouth the ventral surface of the cephalic cone is slightly excavated along the median line. The abdominal disc is apparently much contracted, for its free edge is rolled inwards to such an extent that the ventral surface and the terminal disc are visible in part only. The ventral surface is, so far as it lies open to the observer, densely covered with the well-known "papillae," or "pseudo-suckers" bearing on their summits small slit-like openings. Some of these organs are everted and, in this state, represent small knobs projecting somewhat over their retracted neighbours. On inspecting the worms with a magnifying glass, a small circular hole surrounded by a somewhat raised brim becomes visible in the midventral line about 1·35 to 1·5 mm. distant from the base of the cephalic cone. It was present at the same place in all the

specimens and therefore a normal structure, probably the genital aperture. If the latter was true then the worms could not belong to the species *aegyptiacus*, for in this, the genital aperture is placed immediately behind the cephalic cone, at the very base of the projecting edge of the disc.

A close microscopical examination of the three specimens kindly given to me by Dr. STEPHENS has confirmed this presumption; the parasites represent a new and at the same time a true member of the genus *Gastrodiscus*. It appears superfluous to give a description of its internal structure here, for this would mean nothing but a second description of the structure of *Gastrodiscus aegyptiacus*. It may therefore suffice to point out the differences between the two species. They are chiefly given in the position of the genital aperture and the extension of the yolk-glands. The former has already been mentioned; it is a circular or transversely oval opening about 0·3 mm. wide, and leads into a genital atrium of 0·3 mm. in cross diameter, the muscular wall of which is of considerable thickness and much more conspicuous than in the African species. The floor of the atrium is again raised in the shape of a conical papilla on the top of which the male and female genital ducts open close by one another in minute pores. The yolk-glands show a richer development than in *Gastrod. aegyptiacus*. In this species, it will be remembered, they are located in the ventral half of the body, between the intestinal caeca and the free margin of the disc, and it is rather exceptional to find some folliculi extending below the caeca into the space between these and the median line of the body. In *Gastrodiscus secundus*, the yolk-glands trespass on the intestinal caeca in such a manner that their loosely grouped follicles occupy, in the ventral half of the body, all the space left free by the other organs. A minor difference is afforded by the size of the suckers. The oral sucker which, in *Gastrod. aegyptiacus*, presents a cross diameter of 0·8 mm shows, in *G. secundus*, a diameter varying, according to the size of the specimens, from 0·55 to 0·65 mm.; the posterior sucker, in *G. aegyptiacus* about 2 mm. wide, in *G. secundus* scarcely reaches 1·2 mm. in size. The uterus, in the body of the new species, principally takes the same course between the organs as in *G. aegyptiacus*, but, although it is, in the two larger individuals at my disposal, thickly filled with ova, it seems that it does not form so many secondary loops as in the older species. The ova

which, in the latter, show a length of 0·17 to 0·19 mm. and a width of 0·11 mm., are, in *G. secundus*, somewhat smaller namely 0·15 to 0·16 mm. long and 0·09 to 0·1 mm. wide.

Opisthorchis sinensis (COBB.) 1875.

Several worms of a rusty yellow colour contained in a jar of unknown origin and labelled "*Distoma sinense* COBBOLD" struck me at once by the fact that they were considerably larger and stouter than any others I had seen of the species up to that time. I therefore had no hesitation in expressing the opinion that these worms could not be the true *Opisthorchis sinensis*. Since the number of specimens was limited, I took two specimens only with me, an unhurt one and another which was broken into two pieces. About a fortnight after my visit to Liverpool I paid a visit to the "Institut für Schiffs-und Tropenkrankheiten" in Hamburg. Dr. FÜLLEBORN very kindly showed me round and, during an inspection of the collection of human parasites, I was rather surprised to recognise under the designation "*Opisthorchis sinensis*" the same large form which I had seen a short time previously in Liverpool. There were about a dozen individuals, part of them kept in spirit, others mounted as microscopical preparations. They had all been collected from one case, a Chinaman who had died in the Seamen's Hospital in Hamburg. Besides these large specimens, there was one microsopical preparation of an ordinary small specimen such as those I had alone seen before. This specimen was *not* derived from the case from which the large worms had been obtained. Dr. FÜLLEBORN was kind enough to confide this whole material to me for comparison with the Liverpool specimens. On my return to Egypt, four weeks later, I learned that a short time previously, a great number of "liver flukes" had been found at the post-mortem examination of a Chinaman who had died in the British Hospital of Port Said. Suspecting a case of Opisthorchiosis I wrote to Dr. E. H. ROSS, Public Health Officer of the Town and Port of Port Said, to ask for some specimens of the worms. Thereupon, Dr. CUFFEY, who had had the patient under his care and had made the post-mortem examination, most obligingly placed at my disposal all the preserved material of the case. He was also kind enough to write a short abstract of it which I insert in full here

because of some interesting particulars it contains.* The preserved material sent to me consisted of about 200 loose worms, and many others were still seen densely packed in the bile-ducts of some preserved pieces of liver. Among the loose worms there was again not a single specimen of the ordinary small variety, but all were the large form. I had thus, within a very short lapse of time, thrice come across a variety of the Chinese liver-fluke which I had never seen before, and in all these three cases this variety had been present alone, quite unmixed with individuals of the usual smaller variety.

I had not the least doubt that this new form would prove to be an independent species and that it would be easy to delimit it anatomically from its smaller congener. I was therefore somewhat disappointed, when after a most minute and thorough comparison of the specimens with those I possessed of the small "*Distoma sinense*," I could not, apart from the size of the body and the ratio of the suckers, find any constant internal differential character between them. Even of the characters mentioned the last-named is by no means conspicuous, and I had almost made up my mind that the two varieties must be considered as one and the same species, when, on reconsidering all the factors involved, I came to the conclusion that

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* A CASE OF DISTOMIASIS OF THE LIVER AND THE DUODENUM.

Too-ting, a Chinaman, aged 25, was admitted to the British Hospital, Port Said, on May 10th, 1906, suffering from Lumbar Abscess. He was landed from a ship proceeding from China to England. The abscess was pointing in the lumbar region, posteriorly, 2½ inches from both the middle line of the back and the crest of the ileum. It was opened and about 300 grms. of bile-stained pus were evacuated. The walls of the abscess were explored and the transverse process of one of the lumbar vertebrae was found to be necrosed. But no connection could be found between the abscess and the liver. The cavity was washed out and stitched up. Subsequently a drainage tube had to be inserted, for the pus collected again; but the man's condition rapidly improved, and the wound over the site of the abscess healed completely.

On June 21st, the man suddenly developed pneumothorax, affecting the lower part of the right side of the chest. As he was thought to be suffering from an abscess of the liver, this organ was explored again, but no pus was found. Oedema occurred over the lower part of the right side of the chest and still no pus could be found on exploration. The patient rapidly became worse, and died on June 25th.

Post Mortem.—The abscess in the lumbar region had healed completely. No reason for it could be found beyond the necrosed vertebra.

Liver: The liver was enlarged and contained numerous abscesses in both lobes. They varied in size from that of a small pea to a tangerine orange. On section the liver presented hundreds of liver flukes in the bile-ducts. The hepatic ducts, common bile duct, and gall-bladder all contained numbers of these flukes.

They were also found free in the duodenum, but not in the ileum.

There were no flukes in the abscesses.

No cause for the pneumothorax could be found, and no connection between it and the liver was apparent. All the other organs were normal.

(Signed) EDWARD CUFFEY,
Medical Officer, British Hospital,
Port Said.

such a ruling would be less defensible than the other alternative, viz. to declare them as separate species.

I am pretty certain that many of my fellow-helminthologists will think I am pushing things too far, and that what I am about to do here is nothing but "species-manufacturing." In order to meet this reproach as far as I can, I may be permitted to give my reasons somewhat in detail.

To begin with, it is a fact acknowledged by all observers who have dealt with this particular group of parasites (BRAUN, LUEHE, MUEHLING, LOOSS) that the members of the genus *Opisthorchis* are in many instances by no means easily to be distinguished. As one out of several examples I will mention the case of *Opisthorchis felineus* and *Opisthorchis geminus*, a case observed by myself. The former species is in Europe a rather common parasite in the liver of certain beasts of prey, and especially in cats, and is in eastern Europe even a not uncommon occasional parasite of man. *Opisthorchis geminus* inhabits in Egypt the liver of certain birds (*Milvus aegyptius*, the common Egyptian kite, *Circus aeruginosus*, a glede, and *Anas boschas fera*, the wild duck). It resembles *Opisthorchis felineus* anatomically to such an extent that the two forms are hardly distinguishable from one another without knowledge of host and locality. Their internal organisation, therefore, would not furnish unobjectionable reasons for separating them specifically; nevertheless, they must be considered as specifically different on biological grounds —or else we must admit as true certain circumstances which are almost impossible to comprehend. Among the hosts of *Opisthorchis geminus* *Milvus aegyptius* is a true Egyptian who never leaves the country and thus must acquire his parasites *in* it. But if *he* does, it would be inconceivable why dogs, cats and even Man—hosts that in Egypt actually *share* other species of parasites—should not pick them up also and become infected as they do in Europe, *if* the parasite of the Egyptian birds and that of the European mammals were indeed one and the same organism. Never, however, have I in Egypt found any trace of an *Opisthorchis* form in canine or feline animals, wild or domestic; nor in Man, although I have purposely looked for them whenever there was an occasion; nor have the professors of pathology who within the last ten years have made the post-mortem examinations at Kasr-el-Aini Hospital noticed anything of the sort. It can therefore

be considered as certain that no *Opisthorchis* species occurs in mammals and Man in Egypt and the inference therefrom *must* I think be that the Avian *Opisthorchis* which is indigenous in this country cannot be the same species which inhabits mammals and Man in Europe—all the resemblance they show in their internal organisation notwithstanding.

The case of *Opisthorchis felineus* and *Opisthorchis geminus* is not the only one known; but this as well as the corresponding instances tend to show that, in the case of the two *Opisthorchis sinensis*-forms also, the internal similarity must not necessarily be a proof of their specific identity—the less so, as in the size of their bodies and the ratio of their suckers characters are given which practically allow a differentiation of the two forms.

A second point which seems to me very important is the fact that the two varieties of *Opisthorchis sinensis* not unfrequently occur quite separately. It has already been pointed out that the large variety was present alone in the three cases mentioned above; but the same fact may be inferred from some earlier cases on record. The parasite was discovered in 1874 by McCONNELL; the measurements given of the worms by the author are $\frac{7}{10}$ in. for the length and $\frac{1}{7}$ in. for the breadth. This would correspond to 17·8 and 3·63 mm. respectively and is, as may be mentioned here in anticipation, exactly the size of the specimens I at present possess of the large variety.* The author

* It is perhaps not out of place here to draw attention to the fact that the size of preserved specimens of parasitic worms is within certain limits influenced by the methods of preservation on the one hand, and by their own condition at the moment of preservation on the other. If specimens are collected from a living or recently killed host, they are still alive; if they remain in the organs after the death of their host they will die, too, after a shorter or longer time; the same thing happens when living parasites are brought into water, which is very harmful to them and destroys certain species very quickly. Before death they stretch themselves to their full size, and the commencing decomposition even makes them swell somewhat. Living parasites, when preserved immediately after removal from their natural habitat, always react by a contraction, which is the stronger the slower the preserving reagent acts upon them. Specimens which have died—in water or in the organs of their hosts (as is usually the case in post-mortem examinations made some time after death and in warm climates)—do no longer contract, but may shrink more or less according to the dehydrating power of the preserving fluid. All these factors, therefore, have their influence upon the dimensions the specimens exhibit after preservation, and it is necessary to remember this fact when the size of a certain species is used as one of its distinctive characters. However, the changes due to preservation always keep within certain narrow limits, and can even be fixed by actual observation. The parasites of the Port Said case were obviously dead when they came into contact with the preserving fluid, for they are not contracted. The fluid used had been formaline, which does not dehydrate; thus, the specimens show an average length of 16 to 18 mm., which is about their natural length at full extension. Some of them were afterwards most carefully and gradually transferred into alcohol; when the strength of this had reached 90 per cent. the worms had shrunk to a length of 14 to 16 mm., but could be made to very nearly assume their former length again by placing them back into formaline.

adds that the breadth is very constant in all the specimens, whereas the length presents slight variations from $\frac{6}{10}$ in. to $\frac{8}{10}$ in. (= about 15·3 to 20 mm.). In 1877, the parasite was recorded by MACGREGOR as the possible cause of a peculiar form of paralytic disease, of which he had seen three fatal out of eight cases. The observations were made in Port Louis, Mauritius, but all the patients were again Chinamen. I have at present no access to MACGREGOR'S original article, but the parasites found and described by him were subsequently examined by COBBOLD and recognised as identical with those of MCCONNELL. In 1878 MCCONNELL himself describes a second case observed by him in Calcutta; "the subject was, curiously enough, again a Chinaman," and the distomata found "were quite identical with those originally found." Comparing these earliest observations we see that in all cases the bearers had been Chinamen, and that the parasites must have been of about the same size for no allusion is made to the existence among them of any noticeably smaller individuals.

In 1883, the presence of flukes in the liver of Man was reported from Japan, first in a paper written in Japanese ("Observations on Distomes in the Lung and Liver") by KIYONO, NAKAHAMA, SUGA and YAMAGATA, acting physicians in the hospital of Okayama, and a short time later by BAELZ in a paper "Ueber einige neue Parasiten des Menschen." Unfortunately, I have at present no access to this paper which is one of great importance for the question I am now discussing; thus I can here refer to its contents so far only as they are reproduced by later writers. According to these, BAELZ recognises two distinct species of liver-flukes, a *Distoma hepatis endemicum* sive *perniciosum*, and a *Distoma hepatis innocuum*. They are distinguished from one another (see LEUCKART, 1876, p. 338), first and foremost by their quite different size, *Dist. innocuum* attaining a length up to 20 mm., whereas *Dist. endemicum* does not exceed 8 to 11 mm. Of the other differential characters given by BAELZ the following seem to me to be worth mentioning: *Dist. innocuum* has (1) a uterus of lighter colour but larger volume, (2) slightly larger ova than *Dist. endemicum*, and (3) possesses in its excretory apparatus and body-parenchyma numerous black granules. The exact measurements of the ova are, according to BAELZ, in *Dist. innocuum* 0·021 to 0·036 mm. length by 0·018 to 0·002 mm. breadth, in *Dist. endemicum* 0·02 to 0·03 mm. length by 0·015 to 0·017 mm.

breadth. From the names given to the species it may be inferred that the small variety is very common in the country ("endemic") and harmful to its host ("pernicious"), presumably because of its occurrence in large numbers, whilst the larger is rarer, i.e. not present in large numbers and therefore comparatively harmless ("innocuous").

In subsequent years the Japanese liver-flukes were the object of repeated scientific investigation. It was soon recognised that they bore a close anatomical resemblance to the Chinese liver-fluke discovered by McCONNELL; as a matter of fact, all later authors are agreed in declaring them more or less definitely as identical with one another as well as with the *Distoma sinense*. A comparative study of the papers published by these authors, however, reveals an interesting fact, namely that so far as specimens of Japanese origin are concerned these authors, with one exception, do not seem to have ever again seen the large variety, i.e. the *Dist. innocuum* of BAELZ. Thus in 1886, IJIMA, when describing *Dist. endemicum*, gives the average length of the body as $11\frac{3}{4}$ mm., whilst the largest specimens measure 13, the smallest 8 mm. in length; the breadth is 2 to $2\frac{3}{4}$ mm. LEUCKART who named the *Distoma sinense* of COBBOLD *Distomum spathulatum*, examined part of BAELZ'S original material and specimens sent to him by IJIMA; he found the worms to vary in length from 10 to 13 mm. and in breadth from 2 to 3 mm. I saw this material myself at the time and do not remember having noticed any remarkable difference in size of the specimens. In 1900, KATSURADA published a very exhaustive paper based upon 76 post-mortem examinations in which altogether an enormous number of parasites were found; in 21 cases indeed their number exceeded 1,000 and in five there were between 2,000 and 5,000. It may be mentioned here in passing that KATSURADA for the first time states that in cases of strong infection the parasites also occur in the pancreatic ducts causing there sometimes no perceptible changes, but generally a dilatation of the ducts combined with a thickening of their walls; occasionally, one may even observe inflammatory infiltration and hypertrophy of the connective tissue in the neighbourhood which seems to lead to atrophy and degeneration of the glandular substance.

With regard to the question which interests us here, it is to be regretted that KATSURADA does not give exact measures of individual specimens, but averages only derived from measurements of a certain

number of worms found in separate cases. Thus, five individuals measured of one case gave an average of 11·0 mm. length by 2·50 breadth; 21 individuals of another case gave an average of 9·78 mm. length by 2·40 mm. breadth; and 35 individuals of a third case gave 14·06 mm. by 3·88 mm. Nothing need be said concerning the two first cases; in the third, however, it is almost certain that large individuals of 16 to 18 mm. length have been present, although the author does not mention it especially. KATSURADA explains the variations in the size of the worms by circumstances such as size of the host, number of parasites actually present at the same place, &c., and says that "in cases where few worms only inhabit a full-grown man many of more considerable size are found among them; whilst, on the contrary, in children, dogs and cats the worms are generally smaller."

This view, by the way, which was still very generally adopted not so many years ago, is not supported by actual observations. I have for several years paid special attention to this question, but all my experiences tend to show that every species of parasite has a size of its own. There *may* occasionally be individual specimens which trespass the normal size of their race more or less markedly (just as this occurs in Man and higher animals), but, as a rule, their size is very much the same, whether they live in a large or in a small host. A full-grown *Ascaris lumbricoides* is as large in a child of one year's age as it is in an old man of seventy; and the common liver-fluke is not smaller in a goat or a sheep than it is in a cow, nor is it, when full-grown, smaller in a narrow bile-duct than in a wide one. In the above mentioned case of *Distoma sinense* observed by Dr. CUFFEY, the worms thickly crowded the bile-ducts of medium calibre; nevertheless, not a single small specimen could be detected among the loose ones. The small *Distoma endemicum*, on the other hand, retains its specific size quite irrespective of the number in which the individuals may be present in a given host.

The observations so far spoken of had all been made on material collected in Japan. During the same time, however, the parasite had also been discovered in subjects coming from other parts of the Extreme Orient, such as Corea, Tonkin, and the island of Formosa. I do not possess the special literature on these earlier cases, but may refer the reader to an article by R. BLANCHARD, "Note sur quelques

vers parasites de l'homme (1891)" in which the necessary references are given. In this same article BLANCHARD also records three new cases from which the parasites obtained had been submitted to him for examination. The material consisted of two bottles containing each several hundreds of *Distoma sinense* which had been collected at the post-mortems made of two Annamite soldiers in the military hospital of Hanoï. A third bottle from Hanoï contained, in addition to a piece of liver, an extraordinary number of parasites; so many indeed that the author says that without the positive affirmation given it would have been hard for him to believe that they had actually been derived from one and the same autopsy. At another place (1901, p. 581), he says that one might estimate the number of these worms as being rather above ten thousand. The statements BLANCHARD makes with regard to the external aspect of the parasites are so interesting that I reproduce them in the original language (1891, p. 5). "Dans l'un des deux flacons reçus de Mr. le Dr. TREILLE (i.e. those mentioned above in the first place), tous les Distomes sont de grande taille et semblables entre eux. Dans le second flacon, ainsi que dans celui que j'ai reçu du Dr. LOYE (the third bottle), on remarque au contraire des Vers de deux sortes: les uns, d'aspect très foncé, longs de 14 millimètres, larges de 3 mm. 2; les autres, beaucoup plus clairs et mesurant seulement 8 millimètres sur 2 millimètres."

Thus, there was again one case in which the large form was present alone, whereas in the other two both were represented, but so clearly recognisable from each other that the author immediately goes on saying: "A première vue, on dirait qu'il s'agit de deux espèces distinctes . . ." The conclusions drawn by BLANCHARD from these observations will be discussed later on; on the present occasion, I wish to draw attention to the fact that the large specimens were "d'un aspect très foncé," or, as I interpret it, strongly pigmented, whilst the smaller specimens were "beaucoup plus clairs," that is to say without pigmentation. The size of the worms recorded by BLANCHARD is somewhat below the average for both varieties, very probably, therefore, they are somewhat contracted owing to the action of some stronger reagent.

Reviewing now what has been recorded on the preceding pages we have the following facts:—The original *Distoma sinense* of MCCONNELL and COBBOLD has up to now chiefly been found in

Chinese and is at present the only species of liver-fluke known from this race. It reaches an average size of 18 by 3·5 mm. and has a more or less opaque body owing to the presence within the body parenchyma of granules of a dark pigment. In Japan, similar flukes are also very common in the liver of Man and certain animals; but here they vary, especially in size, to such an extent that one of the first observers (BAELZ) felt justified in establishing two distinct species. One of them coincides in size with the *Distoma sinense* and also possesses the pigment granules in its body parenchyma. It is, in Japan, apparently not very common, for some observers subsequent to BAELZ have not come across it at all during their investigations, whereas BAELZ himself considered it as harmless—presumably because he never saw it in large numbers—and KATSURADA explains the large size of the specimens he saw in certain of his cases by the fact of few individuals only being present at the same place. The second species is markedly smaller, attaining an average size of 11 to 12 by 2 mm. only; it is not pigmented and appears to be very common in Japan as indicated by the name "endemicum" and, furthermore, by the fact that several observers saw this form alone during their researches. There are finally the three cases recorded by BLANCHARD; in one of them only large worms were present, in the two others, a large and a small variety were found, the former remarkable by its dull colour, the latter much lighter.

From these observations I cannot but draw the conclusion that in the two differently sized varieties of the *Distoma sinense* we actually have to deal with two independent forms. One of them (the larger) is indigenous on the Asiatic continent, especially China, but is occasionally also found in Japan (and probably the other islands of Eastern Asia), the other is indigenous in Japan and common also in Annam and Tonkin (possibly all along the sea-shore in the Far East).

This view differs from the conclusion arrived at by BLANCHARD. As quoted above, his first impression on seeing the two different sizes was that he had two distinct species before him; a close comparative examination, however, convinced him of the contrary. "La disposition anatomique est la même dans les deux cas; la structure et les dimensions de l'oeuf sont également indentiques. On constate simplement que les plus petits individus ont les vitellogènes moins

développés et l'utérus chargé d'oeufs en moins grand nombre. Cette observation démontre donc que les petits individus sont des jeunes, non encore parvenus à toute leur croissance ; elle explique en même temps leur aspect plus clair." I may confess that for a certain time I held a similar view ; but it cannot be upheld any longer for the following reason : Supposing that the small individuals were indeed young, i.e. in the beginning of the period of their sexual activity, one ought to expect that the large individuals would be without exception perfectly sexually mature and full of ova. But this is actually not the case. In the Hamburg material I have for examination there are two immature specimens, both with a uterus developed to its full length but containing, in the first specimen, only spermatozoa (the seminal receptacle containing nothing but a number of egg cells), and in the second specimen a number of loosely grouped ova which are still far from filling the coils as they do in ripe individuals. Nevertheless, these worms are unmistakeable representatives of the large species, for they measure, the first 13·5 by 2·5 mm., the second 12·5 by 2·75 mm. ; they show, in addition, the size of the suckers and the brown pigmentation distinctive of that form. One similar specimen was found in the material from the Port Said case. For all of them, the explanation alluded to above does not hold good ; they prove, on the contrary, that the large species when the period of its sexual maturity begins has already reached, or even exceeded, the maximum size of the small form. Unfortunately, the scant material I possess of the latter does not contain any young individuals ; but the fact just recorded suffices I think to show that the two forms cannot be one and the same species.

If they are different the question arises, whether they are to be considered as full species or as mere varieties. I suppose that many of my fellow-helminthologists, regarding, in the first place, the almost perfect similarity of the internal organisation, as compared to which the differences in size, &c., appear insignificant, would find the latter alternative quite sufficient to cover the facts, assuming perhaps so-called " local varieties." I unhesitatingly proclaim the former view as being more logical and more consistent. The chief character of the species, in contradistinction from the variety, lies in the constancy with which it preserves its specific peculiarities. The variety is inconstant in a larger or lesser degree and alternates with typical specimens of the

species. A similarity in the internal organisation, even if it is very close, is not decisive for a variety, for otherwise it would be a simple logical necessity to consider for instance the cat as a mere small variety of, let us say, the leopard or the rat as a large variety of the mouse. Both cat and leopard, and rat and mouse, are internally almost absolutely alike and yet they are no varieties but genuine species, for cat and mouse preserve their specific peculiarities through generations, and never will one of their offspring suddenly be a leopard or a rat, nor will the offspring of a leopard or a rat ever become cat or mouse, although, hypothetically, a simple enlargement (or reduction in size) of their bodies and internal organs combined with some changes in colour, &c. would suffice to transform the one into the other. With regard to these animals, therefore, (and to almost all others as well) the size and some external features, like colour, &c. are not considered as determinative of varieties, but of species, and it is only the higher classificatory units such as genera, sub-families, &c. which become determined by the greater or lesser similarity in the internal organisation. Such principles of classification are, so far as I can see, universally followed by systematists with regard to the larger animals, and I do not see any reason, why they should not be applied to parasitic worms also; so much the more so, as careful observation and comparison reveal among them quite a similar gradual increase (or decrease) of structural differences as exists among the larger animals. I thus hold that it is simply logical and consistent to consider the two *Opisthorchis sinensis*-forms as two distinct species rather than as varieties of one species.

I have in the above explained the reasons for my opinion at some length, because the question what in helminthology is to be considered as a species still needs being definitely settled. It appears that quite a number of writers, zoological and medical, on helminthological subjects still cling to the old assumption that there exist comparatively few species of parasites only, but that these species are capable of varying in size and organisation to a considerable degree according to host, locality, &c. It is my firm conviction that this view must be altogether abandoned if helminthology is to become an exact science based on facts rather than on preconceptions inherited from our forefathers. Neither is it justifiable any longer to declare all at once two forms as identical simply because they agree in their general structure,

nor is it sufficient to-day to give of new forms of parasites a superficial account of some general characters, if such descriptions are to be of real scientific value. It would not be a difficult thing to enumerate dozens of modern papers of this sort; they look and read quite nicely, but nothing would have been lost had they never been published at all. I will not mention any names, nor is it my intention to blame or to offend those who do not share my scientific convictions, but I desire to convince them, in the interest of our particular branch of science, that by this time certain views considered as almost axioms by our predecessors can no longer be upheld.

The question as to the denomination of the two species of *Opisthorchis sinensis* in accordance with the modern rules of scientific nomenclature is easy to decide. There is no doubt that the large form is the same as originally found and described by McCONNELL; it must therefore retain the specific name *sinensis* COBBOLD. The smaller species is, unmistakeably again, the same as first recognised by BAELZ and distinguished under the designation *Distoma endemicum*; I therefore re-establish this specific name for it. Both species are members of a natural genus which might have been created before this on the ground of the peculiar configuration of the testicles, but becomes now more distinctly separated from *Opisthorchis* by the fact that two different forms exhibit the same character.

Clonorchis, n. g., *Opisthorchiidarum.*

Differs from *Opisthorchis* sensu strictiori by the fact that the testicles are not notched or lobate, but distinctly ramified, the branches, crossing the intestinal caeca on their ventral side and extending very near to the body margin. Another difference seems to lie in the shape of the excretory vesicle. In *Opisthorchis* s. str. this is Y shaped with a very long stem running in the form of an S through the space between the testicles and bifurcating at the posterior border of the seminal receptacle into two rather short branches from the tops of which the main excretory vessels arise. In *Clonorchis*, the Y shape of the vesicle is no longer clearly recognisable; the unpaired tube simply becomes somewhat widened at its anterior end assuming sometimes, but not always, the shape of an irregular triangle the two upper angles of which might be considered

as the homologues of the branches in *Opisthorchis* s. str. The main excretory vessels do not arise from these angles, but somewhat farther backward, at about the lower angle of the triangular widening of the tube (see fig. 4).

Type: *Clonorchis sinensis* (COBBOLD) 1875.

Clonorchis sinensis (COBBOLD) 1875.

(Synonym: *Distomum innocuum* BAELZ 1883.)

Full grown specimens vary in length from 13 to 19mm. and in breadth from 3 to 4 mm. At the commencement of the period of sexual activity the body has attained 12 to 13 mm. in length and 2·5 to 3 mm. in breadth; such specimens are recognisable by their uteri in which the ova are comparatively scarce in number and loosely grouped, i.e. with more or less wide empty spaces between the individual ova. The oral sucker averages 0·6 mm. in transverse diameter; the lowest figure I have found in one specimen (of about 60 measured) was 0·52 mm., the largest which is not uncommon 0·63 mm.; usual measurements between 0·58 and 0·62 mm. The ventral sucker averages 0·47 mm. in transverse diameter; lowest figure found in one case 0·39 mm., highest figure observed once also 0·52 mm.; usual measurements between 0·45 and 0·49 mm. The ratio of the suckers thus varies in the main between 15 : 12 and 16 : 12. The pigmentation, i.e. the deposit within the body parenchyma of numerous fine granules of a yellowish or brown substance, is very characteristic of this species. Sometimes it is so little developed that the preserved worms appear white and the pigment granules are only detected in cleared specimens with the microscope, yet may in other specimens assume such an extent that the parasites become perfectly opaque and of a rusty yellow, greyish, or brownish tint throughout. In cases of little pigmentation, the granules accumulate more especially behind the oral sucker in the sides of the pharynx and at the posterior extremity of the body; in a lesser degree along the intestinal caeca and round the outlines of testicles and seminal receptacle. The ramifications of the testicles are fairly long, in accordance with the greater breadth of the body; it may not unfrequently be recognised that in the anterior testicle the branches arise from four, in the posterior testicle from five main stems. All of them lie in about one plane which runs parallel to

the ventral surface of the body; there are however very often, in one testicle or in both, other branches or, more precisely, bulgings of one or two main stems which project towards the ventral surface and appear as thick, compact bodies with irregular outlines. They were already seen by McCONNELL, but interpreted as the whole testicles, whereas in truth they are only parts of them, and are not even constant in their presence. The ovary is usually trilobate, but very often shows, in addition to the large lobes, three to six smaller ones which are sharply separated from the former. The yolk-glands vary somewhat in their extent. They normally reach from the level of the ovary to the ventral sucker, but it is not at all uncommon to see them, on one side or on both, commencing and ending somewhat farther forward or somewhat farther backward of the usual place. They present in *Cl. sinensis*, a striking peculiarity inasmuch as almost constantly a certain number of the groups of follicles of which they are composed remain undeveloped; sometimes one only on one side, sometimes more, on one side or on both; the bands represented by the glands as a whole showing thus one or several interruptions by empty spaces. In perfectly mature specimens the seminal vesicle extends about as far back as the middle of the uterus. The remaining organs do not show any peculiarities.

The average dimensions of the eggs are 0·029 mm. length and 0·016 mm. width; the limits of the former being 0·026 and 0·03 mm., and of the latter 0·015 and 0·017 mm.* In many specimens of the species the eggs show a distinct narrowing towards the anterior extremity, and their rather high lid is marked off by a sharply projecting brim. I have however also seen specimens in whose ova these peculiarities were but little pronounced (see fig. 7).

An interesting variation chiefly observable among the specimens of the Port Said case concerns the colour of the uterus as a whole. In some individuals, this is only a light yellowish-brown, even in the most anterior coils of the organ, whereas in other individuals the whole

* There exist, of course, among the immense number of ova in an individual worm always some which are either larger or smaller than the rest, or even evidently misshapen. In my opinion it is of no use to carefully record the measurements of these eggs also. For the description and definition of a species it is much more important to select for measurement those ova which appear to be normal and to present the size and shape typical for the species. It may be added in passing that young worms with few ova in their uterus usually do not afford normally-shaped and normally-sized ova.

uterus, with the exception of a few of the hindmost loops, appears almost black. As there is otherwise not the slightest difference between the examples of these two extremes—neither in the size of the body, nor in the size of the suckers, &c.—I do not quite know how to account for these variations. To a certain degree, they are evidently due to the number of ova contained in the coils, but to another degree just as evidently to a darker shade of the egg-shells themselves. Since the two extremes described above are not sharply separated, but connected with each other by numerous intermediary tints it is perhaps not unjustifiable to assume that the shell-substance elaborated by the shell-glands becomes darker with the growing age of the parasites, and it may be noted in this connection that the latter live in, and feed on, a coloured substance, the bile.

Clonorchis sinensis is chiefly a parasite of Chinese, but occurs rarely also in Japan—i.e. according to what we know at present. For it is not at all improbable that the worm will be oftener found as soon as attention is paid to its existence; it appears also not unlikely that it may be restricted to certain localities. Up to now it does not seem to have been found in animals.

Clonorchis endemicus (BAELZ) 1883.

This species practically takes the place of the true *Clon. sinensis* in the literature published after 1883 and is at present the one usually described in text books, &c. as "*Opisthorchis sinensis*." Its measurements are given by the authors as 10 to 13 mm. length and 2 to 3 mm. breadth. The smallest specimen actually at my disposal (it comes from the Annamite case described by BLANCHARD) is somewhat contracted and measures 6 by 1·8 mm.; my largest and fairly well extended specimen (of Japanese origin) measures 13 by 2·6 mm.; the remaining individuals range in size between these extremes. The oral sucker averages 0·43 to 0·45 mm. in transverse diameter; smallest diameter observed (in the smallest specimen mentioned above and another one (11 mm. long and 1·6 mm. broad) 0·37 mm.; largest diameter found (in a specimen 10·8 mm. long and 2·3 mm. broad) 0·5 mm. Ventral sucker averages 0·37 to 0·40 mm.; smallest diameters observed 0·33 mm. (in the smallest specimen) and 0·34 mm. (in another long 8 mm., broad 1·7 mm.); largest diameter observed 0·45 mm. (in the largest specimen above mentioned). The ratio of the

suckers varying between about 13 : 12 and 15 : 12 is therefore fairly similar to that in *Clon. sinensis*, but in actual size the suckers are quite different. Among the specimens at my disposal there is none with pigment-granules in its parenchyma. The yolk-glands normally have the same extent as in *Clon. sinensis*, but present similar variations in regard to the relative position of their anterior and posterior terminations as in that species. It may also happen that of the groups of follicles of which they are composed some remain undeveloped, but this occurs, so far as may be inferred from my limited material, much more seldom and the actual state of things is perhaps best described by saying that the absence of one or several groups of follicles is the rule in *Clon. sinensis*, and the exception in *Clon. endemicus*. The seminal vesicle ends (so far as visible) at about the limit between the first and second thirds of the length of the uterus; this character, however, had better not be considered as distinctive because it may vary.

The eggs have about the same length as those of the preceding species (0·026 mm.), but their width is decidedly somewhat smaller, amounting on an average to 0·015 mm. with the lower limit at 0·013, the upper at 0·016 mm. The narrowing towards the anterior end is in the main not so marked and the margin of the rather *flat* lid not so sharply projecting as in *Clon. sinensis* (see fig. 8); but these differences are on the whole very slight and not recognisable in every specimen. With regard to the colour of the uterus as a whole, variations may be found similar to those described in the preceding species.

Clonorchis endemicus, according to existing records, is very common in Japan, and presumably so in Annam and Tonkin too. In Japan the localities especially stricken with the parasite are situated on the sea-shore; it is possible therefore that its geographical range chiefly extends along the shore in the other localities also.

Apart from Man, the species is reported to have been found in certain animals of Japan, such as cats, dogs and hogs. Several specimens taken from the latter host, which I owe to the kindness of Professor JANSON, of Tokyo, are indeed *Clon. endemicus*, for they present all the peculiarities of this species. I am, however, somewhat doubtful with regard to the statement that it inhabits the liver of the cat also—at least as a normal parasite of this animal. In 1886, IJIMA after an examination of specimens derived from this source

writes that the worms "from the liver of cat showed slight differences inasmuch as they possessed very fine spines in the skin and were of smaller size than the former (viz. *Clon. endemicus* of the human liver). Perhaps this cat-distome from Okayama is to be considered as a distinct species, but I firmly believe that in Tokyo, *Dist. endemicum* does sometimes inhabit the liver of cats" (1886, p. 49). This latter possibility can certainly not be denied and is even most probable, but in cases of this sort *Clon. endemicus* appears to be merely an occasional parasite of the cat, whilst the smaller form mentioned by IJIMA probably represents one of its normal parasites. I have examined several cat-specimens which were sent from Japan to Professor LEUCKART in Leipzig years ago (by whom I do not know) and of which Professor CHUN kindly allowed me to take some in exchange for other parasites. They are unfortunately in such a poor state of preservation that not very much is left to be seen in them; the general impression they make upon the observer is certainly rather different from that of the genuine *Clon. endemicus*. If one considers, moreover, their small size (those in my possession do not exceed 4·5 mm. in length and 0·9 mm. in breadth, but are as it seems not yet quite full grown) the presence of fine spines in their skin as reported by IJIMA there is no doubt left that they cannot be *Clon. endemicus*.

A possibility worth being borne in mind in the examination of later cases of human Opisthorchiosis is that this Feline *Opisthorchis* (it cannot as yet be said whether it is an *Opisthorchis* or a *Clonorchis*) may occasionally occur in Man also, just as *Clon. endemicus* is occasionally picked up by cats and hogs. I am even inclined to think that certain statements in KATSURADA'S paper (1900, p. 481) alluding to three worms found in a young man of seventeen from the province of Saga, which presented an average length of 5·16 and an average breadth of 0·96 mm. only, may be explained by such occasional infection with the Feline species.

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EXPLANATION OF FIGURES

Reference Letters.

App.—Lateral pouches of the oral sucker.
C.ex.—Lateral excretory vessels.
C.P.—Cirrus pouch.
D.ej.—Ejaculatory duct.
Disc.—Edge of the ventral disc.
Gr.—Retracted grooves ("pseudo-suckers").
Gr'.—The same organs, everted.
Int.—Intestine.
L.C.—Laurer's canal.
l.Test.—Left testicle.
Met.—Metraterm.
Nerv.—Nervous system.
Oes.—Oesophagus.
Ov.—Ovary.
P.ex.—Excretory pore.
P.Gen.—Genital aperture.
Phar.—Pharynx.
P.P.—Pars prostatica.
R.sem.—Seminal receptacle.
r.Test.—Right testicle.
Sh.Gl.—Shell gland.
Ut.—Uterus.
Vag.—Vagina.
V.ex.—Excretory vesicle.
V.ex.lat.—Lateral branches of the excretory vesicle.
Vit.—Yolk glands.
Vit.D.—Unpaired vitelloduct.
V.sem.—Seminal vesicle.

Fig. 1.—*Eurytrema pancreaticum.* Specimen from Japan seen from the ventral aspect. Enlargement about 11.

Fig. 2.—*Eurytrema coelomaticum.* Specimen from Hong-Kong seen from the ventral aspect. Enlargement about 11.

Fig. 3.—*Gastrodiscus secundus* seen from the ventral side. Enlargement about 11. The opening in the anterior part of the ventral surface leads into the genital atrium from the bottom of which the papilla bearing on its top the male and female genital openings arises.

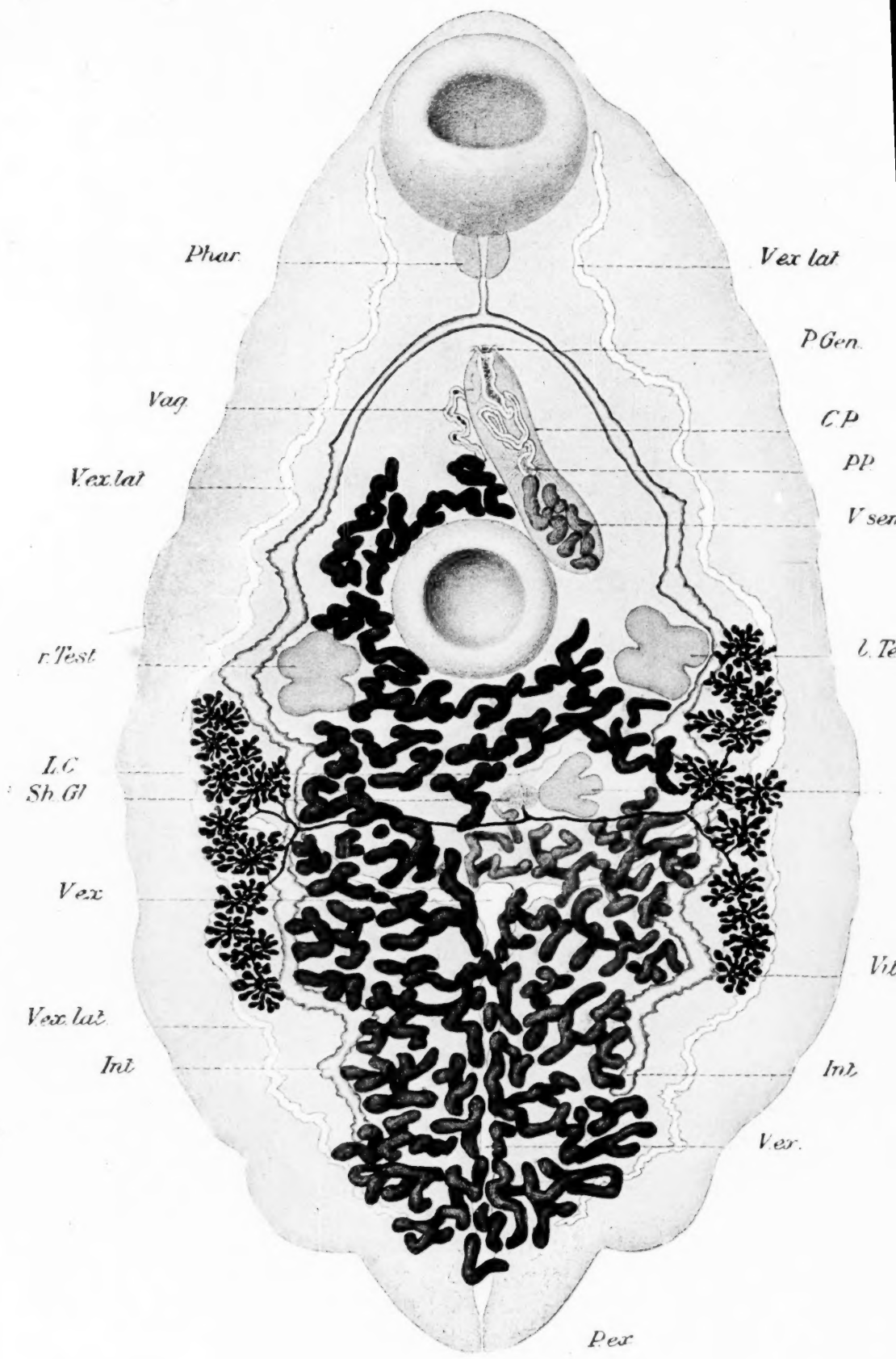
Fig. 4.—*Gastrodiscus secundus.* Median sagittal section; the organs cut in it have been completed from the neighbouring sections so as to give a general picture of the internal organisation. Enlargement about 16.

Fig. 5.—*Clonorchis sinensis.* Specimen from the Port Said case. Ventral aspect. Enlargement about 9.

Fig. 6.—*Clonorchis endemicus.* Specimen from Okayama, Japan. Ventral aspect. Enlargement exactly the same as that of the preceding figure so as to allow of an appropriate comparison. The unequal length of the intestinal caeca visible in this specimen is accidental and not present in other individuals.

Fig. 7.—*Clonorchis sinensis.* The chief forms presented by the eggs, each egg taken from a separate specimen of the worm. Enlargement ca. 990.

Fig. 8.—*Clonorchis endemicus.* Eggs figured in the same manner and under exactly the same enlargement as in the preceding drawing so as to allow of comparison.



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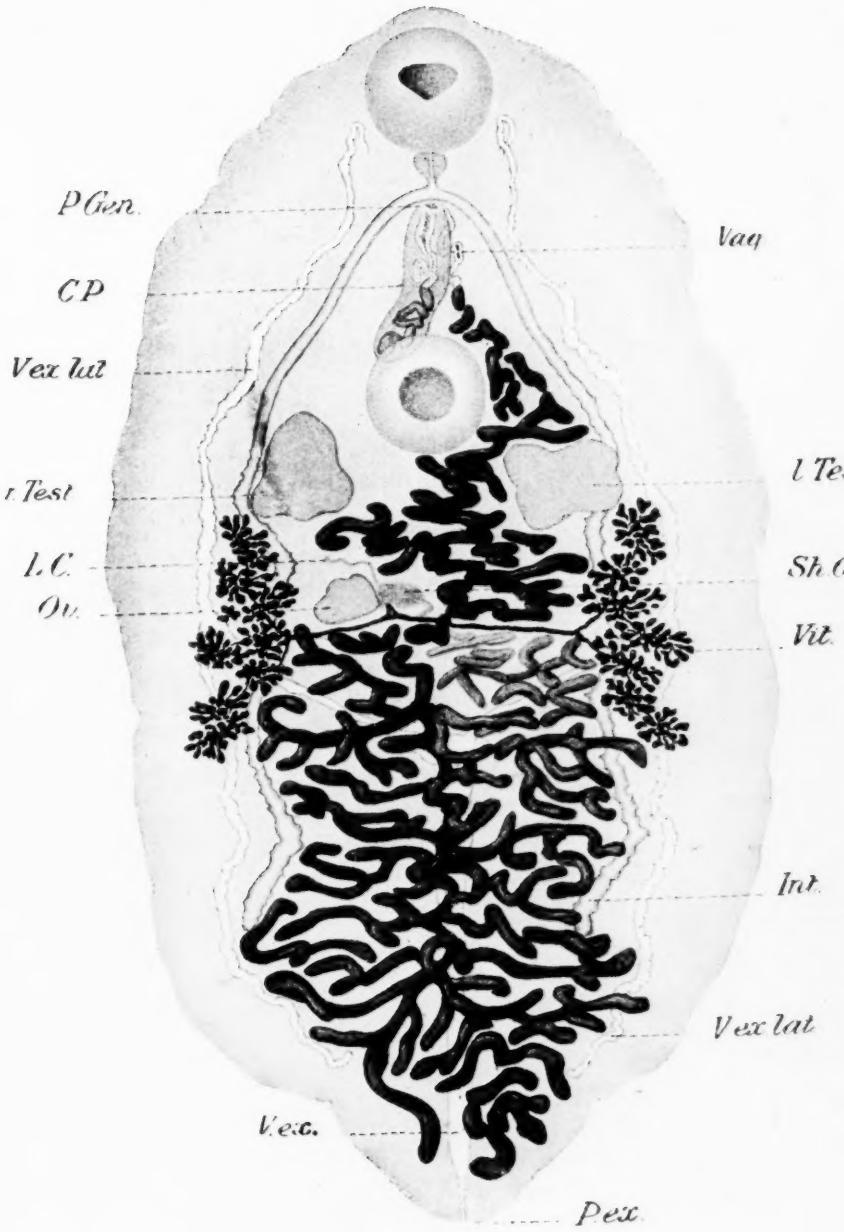

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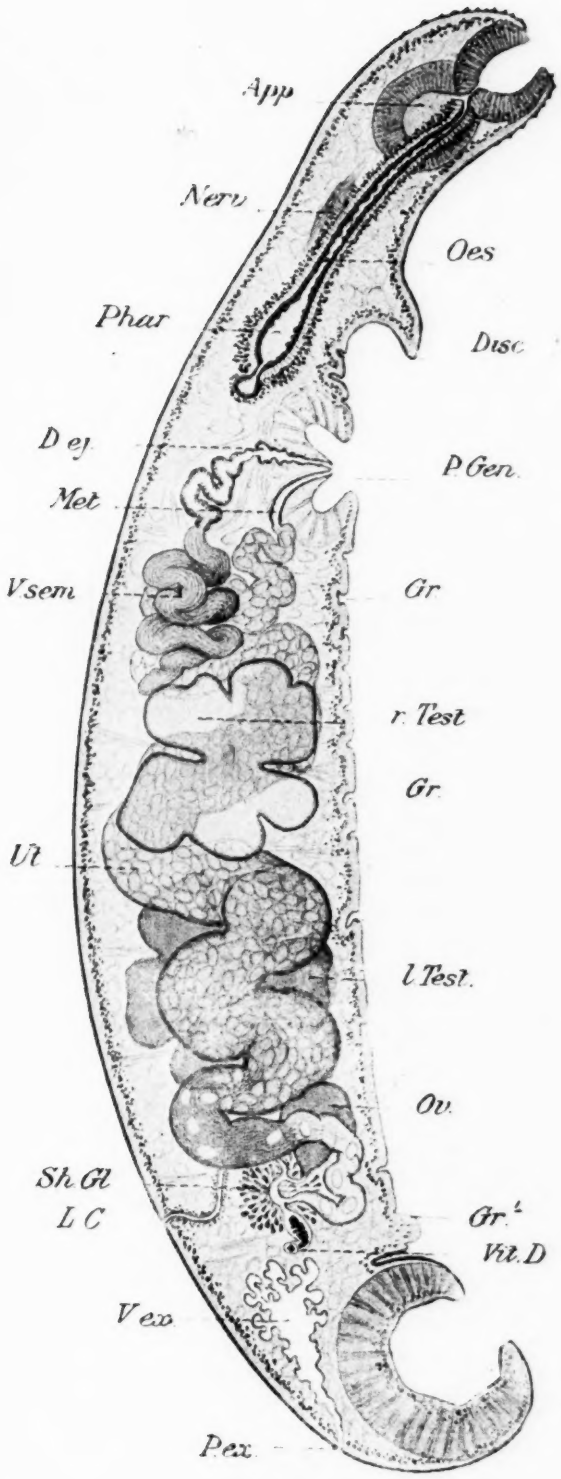
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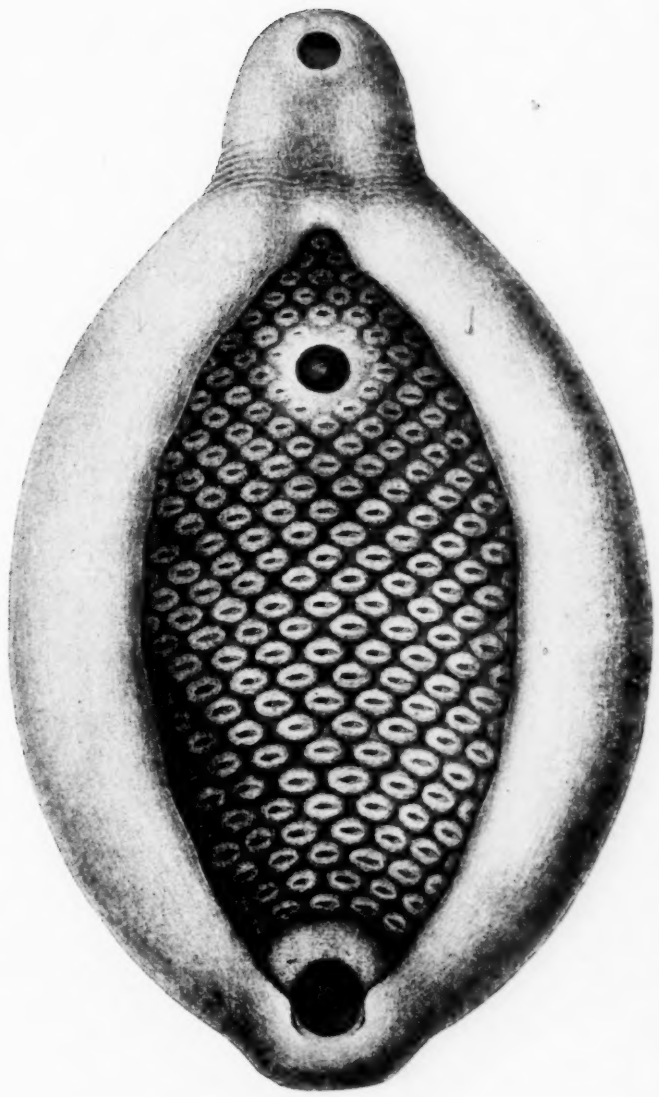

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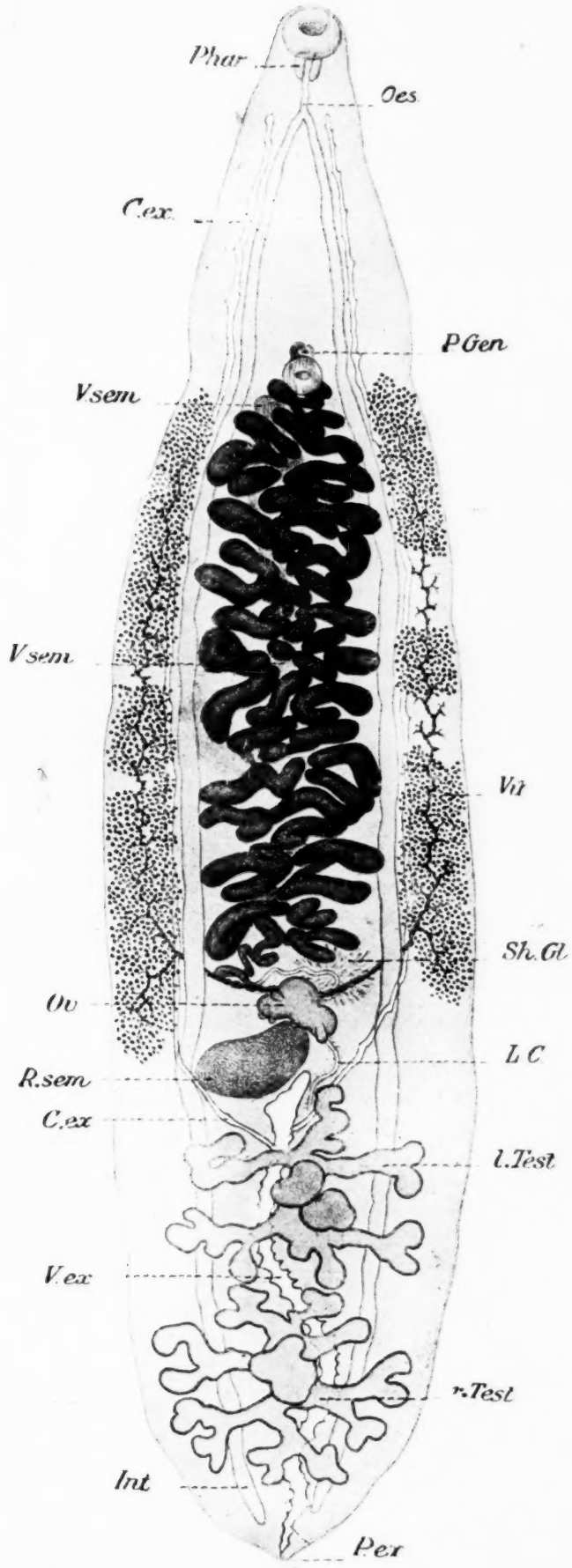

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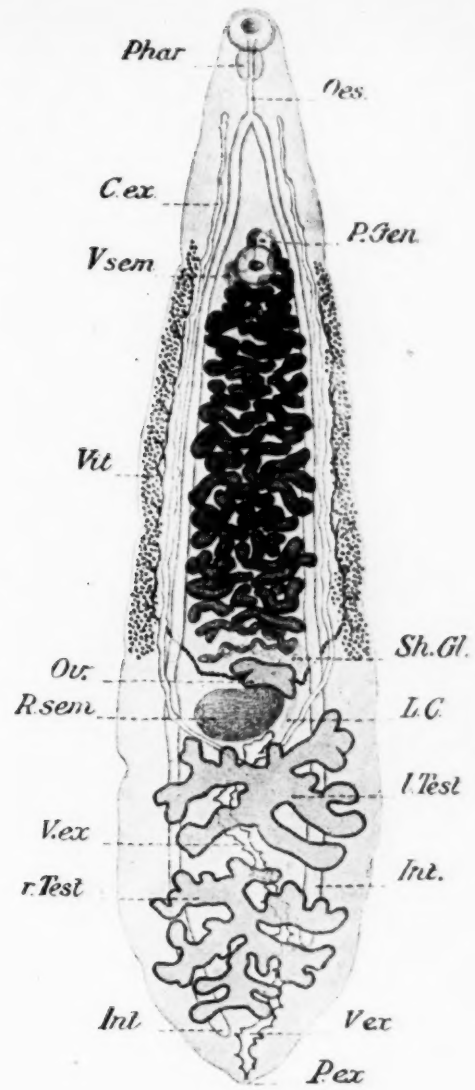

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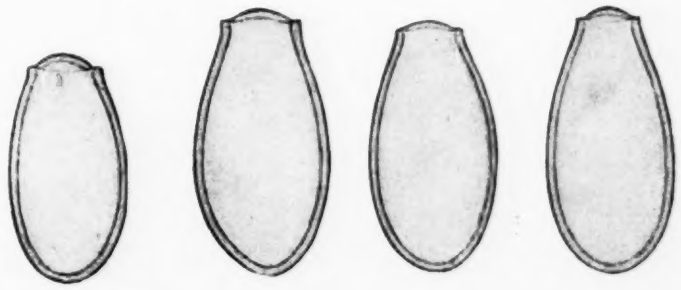

Fig. 8.

THE PRESENCE OF *SPIROCHAETA DUTTONI* IN THE OVA OF *ORNITHODOROS MOUBATA*

THE PRESENCE OF *SPIROCHAETA DUTTONI* IN THE OVA OF *ORNITHODOROS MOUBATA*

BY

CAPT. R. MARKHAM CARTER, I.M.S.

From the Runcorn Research Laboratories of the Liverpool School of Tropical Medicine

Koch, while discussing the question of the transmission of *Spirochaeta duttoni*, the organism of African relapsing fever[1] states that he finds on the surface of the ovaries of infected ticks large numbers of spirochaetes. He considers that these organisms multiply in this position in the tick. He further states that the eggs, when first laid, show scanty infection, whereas in those examined later he describes the occurrence of spirochaetes in vast numbers arranged in densely-tangled masses. This he considers an undoubted proof of the rapid multiplication of the spirochaetes in the eggs. Lastly, he again draws attention to the fact that ticks bred from batches of infected eggs transmit the disease.[2] The following observations were made with the object of confirming the second of these important statements.

Forty-two, naturally-infected, adult specimens of *Ornithodoros moubata*, collected in the Congo Free State, were fed on January 27th, 1906, upon an animal infected with *Spirochaeta duttoni*. These ticks were again fed on an uninfected rat on July 26th, 1906. This rat showed infection on August 1st, innumerable spirochaetes to the field were seen on August 11th. As no eggs were laid, the ticks were again fed; ovulation then commenced, but it was very scanty. Some twenty-six adults were therefore fed once more on an uninfected rat ten days later. Large numbers of eggs were now found in batches about the dish; 32 ova were taken from different collections of these eggs and microscopically examined to determine the presence or otherwise of the spirochaetes. Six of them were found to be infected.

The method used was as follows:—The egg, having been placed

in the centre of the slide, was pricked with a very fine capillary tube, and the contents were quickly withdrawn until the egg capsule became transparent and collapsed. The egg contents were then emptied, forming a tiny drop, on the slide, which drop was quickly smeared into a thin film with a fine-pointed, cold, glass rod. The more rapidly these stages succeeded each other, the greater the perfection of the difficultly made film. The preparation was quickly dried at 45° C. and was then fixed in absolute alcohol before being stained by a modification of Romanowsky's method;[3] finally the smear was examined with a Zeiss apochromatic 2 mm. objective and a No. 18 compensating eyepiece, fitted to a tube length of 250 mm. (× 2250).

The number of the spirochaetes found varied from but three in the whole contents of an egg, to as high as 45 counted parasites to a field, with, in addition, one or more spindle-shaped collections of innumerable organisms. As was observed by Koch it was found that most spirochaetes occurred in those eggs which had been laid longest.

Morphology of Parasites occurring in the Eggs (see plate X).

As well as the typical forms of the spirochaete, occurring as they did in large numbers, several peculiar varieties were also noted and will be discussed in detail below.

By far the majority of the spirochaetes were of the typical simple spirillar form. These varied in length from 5μ to about 20μ (single parasites), and were seen to occur singly and in groups of three to four. Occasionally, however, and this was seen in the most highly infected eggs, the spirochaetes were arranged in remarkable collections and were often parallel, spiral for spiral, with each other. These groups are occasionally spindle-shaped by reason of the decreasing length of those spirochaetes placed laterally as compared with the longest and usually more central parasites. Otherwise these grouped spirochaetes resemble an unbound bundle of sticks.

As a rule the typical[4] single spirochaete presents no evidence of a nucleus, blepharoplast or undulating membrane and no indications of lateral flagella. As a rule it seems to be a spiral, possibly flat and ribbon-shaped on section. One terminal point of the spirochaete is often deeply stained, but both or either may (fig. 7) stain faintly and taper to a point, possibly to form a terminal flagellum. In, especially, the long forms of the organism, transverse, faintly-staining sections

occasionally occur. These lightly-stained areas occur at about the middle of the parasite and occasionally excentrically in one or more places; this is also particularly noticeable in the exceptionally long forms. It seems as though the deeply-staining, central, chromatic core of the parasite were absent and the more lightly-staining periplast alone remains. The same appearance is seen at the extremities of some parasites; in many the condition is exaggerated until the whole chromatin of the spirochaete exists only as a fragmented succession of granules (figs. 8, 9, 24).

In figs. 19*a* and 19*b* are illustrated peculiar forms. They are large apparently single organisms, in which longitudinal binary division seems to be commencing. The undivided portion of these parasites is normal to within a short distance of its bifurcation. Here its chromatin becomes collected into one or two large granules. The divided portions lie side-by-side in parallel curves, and when fragmentation occurs in them it is noticeable that their corresponding granules lie directly opposite each other.

Swellings, usually occurring one to a parasite, are frequently seen in both normal and fragmented spirochaetes. They occur either terminally or in the length of the parasite and are of three types. The first is the smaller and consists of an oval, homogeneous, deeply chromatinic mass placed either centrally or laterally on the parasite (figs. 26 and 30). The second type is slightly larger, and consists of an oval, lightly-stained vesicle in which two chromatinic granules occur. It lies at the side of the parasite and is attached to it by a very fine connection (fig. 29). This form is by far the rarest; it was seen but once. The third and largest type presents the appearance of a vesicle containing a deeply-staining area, confluent with the length of the parasite, and a lightly-staining portion (fig. 29*a* and 29*b*).

Spirochaetes presenting swellings of the first and last types frequently occurred in small groups. It is to be remembered that the observations recorded here were made on dried and stained specimens alone. I regret that lack of time prevents me from amplifying and confirming these suggestive observations by the examination of fresh specimens and of more carefully prepared material.

From these observations we conclude:—

1. That ticks infected by spirochaetes lay infected eggs.
2. That multiplication of the spirochaetes probably takes place in the eggs.
3. That morphological changes in the spirochaetes also occur in the eggs.

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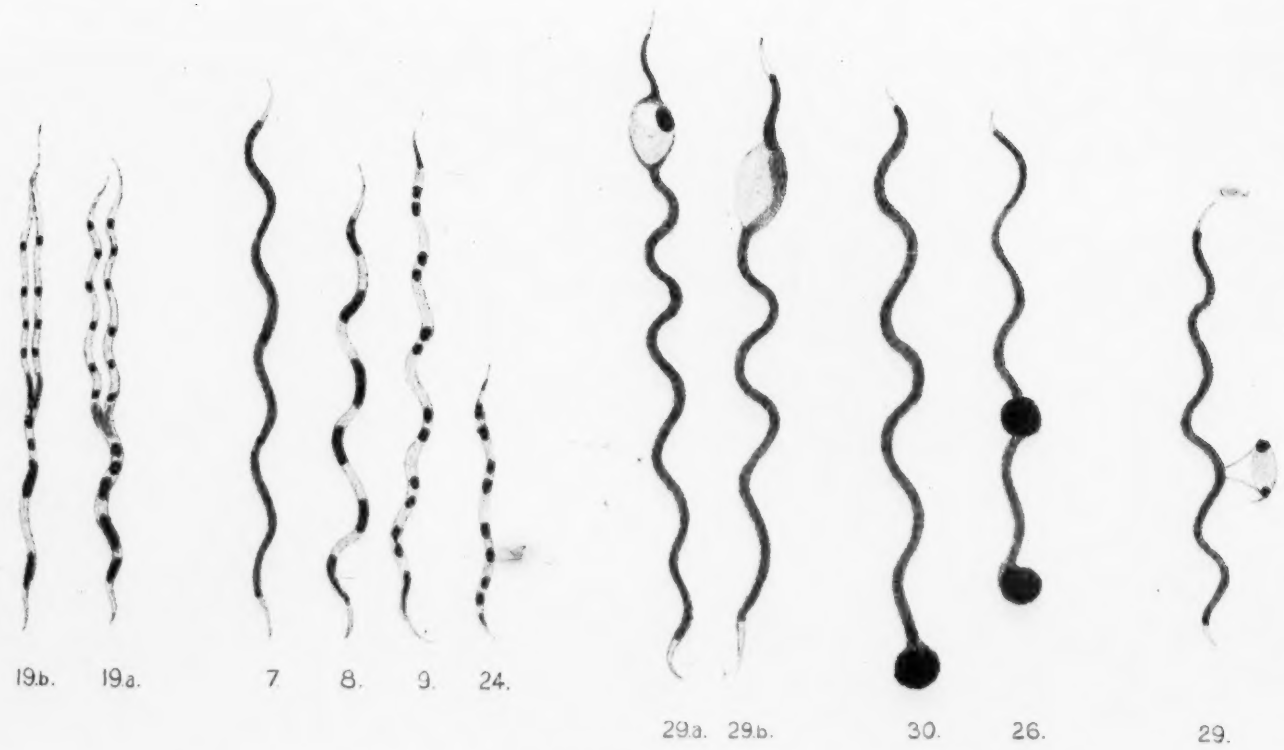

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SPIROCHAETA DUTTONI IN EGGS OF ORNITHODORUS MOUBATA.

R.M.Doe.

PLATE X.

A NOTE ON THE THERAPEUTICS OF TRYPANOSOMIASIS

BY

PROFESSOR BENJAMIN MOORE, M.A., D.SC.

M. NIERENSTEIN, PH.D.

AND

JOHN L. TODD, B.A., M.D., C.M. MCGILL

Thomas and Breinl* found that atoxyl would almost invariably drive the trypanosomes from the peripheral circulation of an infected animal, but, since the parasites frequently recurred, it seemed possible that they might exist somewhere else in the body of their host in a form uninfluenced by this drug. It was therefore determined to commence a series of experiments in which animals first treated by atoxyl were subsequently treated by some other drug. A variety of combinations have been tried. That which has been by far the most successful in the treatment of rats infected with *Trypanosoma brucei* is atoxyl, followed by small doses of bi-chloride of mercury after the trypanosomes have left the peripheral blood. Animal experiments are still in progress.

This communication is made in the hope of inducing those who have opportunities of treating patients to try the effect of atoxyl followed by bi-chloride of mercury on their patients.

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* Thomas and Breinl; Memoir XVI of the Liverpool School of Tropical Medicine.

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